The Bioscan 9(2): 613-616, 2014
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

INFLUENCE OF ENRICHED BIO-DIGESTER LIQUID MANURE ON GROWTH AND YIELD OF FINGER MILLET

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KEYWORDS
Poultry manure
Neem cake
Rock phosphate
Finger millet

Received on :
09.10.2013

Accepted on :
17.03.2014

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ABSTRACT
Application of enriched bio-digester liquid manure (BDLM) with poultry manure & rock phosphate equivalent to 60 kg N ha^{-1} had led lead to the significant grain yield (3893 kg ha^{-1}) and straw yield (7228 kg ha^{-1}) of finger millet compared to recommended practice which was in turn due to growth parameters *viz*., plant height, leaf area index, dry matter production and tillers.

INTRODUCTION

Use of chemical fertilizers has increased the crop yield, but caused many environmental problems including soil, air and water pollution finally human health hazards and making the crop productivity unsustainable. The increasing costs of fertilizers prevent their use by resource poor farmers (Adhikary and Gantayet, 2012). Therefore, general acceptance of organic farming is not only due to greater demand for pollution free food but also due to shortage of synthetic fertilizers. The essence of practicing organic farming lies in the use of naturally available resources like organic wastes, predators, parasites in conjunction with natural processes like decomposition, biological fixation and resistance to achieve the needs of crop production.

Mostly, research on organic production of finger millet was mainly concentrated on the use of FYM, compost, green manure, oil cakes *etc*. These manures alone or in combination could not boost the crop yields. In a long term field trial on finger millet at Bangalore revealed that FYM or NPK fertilizers alone could not produce high yields and not sustainable. Many essential plant nutrients became deficit after two-three decades with them (Gajanana *et al*., 2005). Liquid bio-digester manure has been used for finger millet, paddy, maize, redgram, groundnut, soybean, fieldbean and other crops along with the compost. High crop productivity and improved soil health were noticed with the use of liquid bio-digester manure Anonymous, (2010).

Further, enrichment of bio-digester liquid manure using high quantities of dung, cattle urine, some oilcakes *etc*., had increased the yields of finger millet, groundnut and redgram. However, the studies involving enrichment with poultry manure, neem cake and rock phosphate *etc.,* are needed to raise the content of nitrogen and phosphorus of bio-digester liquid manure. Besides, their effect on crop production is essential for improving the productivity. Now, the agriculture research is focused on evolving ecologically sound, biologically sustainable and socio economically viable technologies and there is need for a fresh look into research agenda to exploit the organic farming approaches using the local manurial sources for growing finger millet. The experiment was conducted with the objective to study the effect of enriched bio digested liquid manure with poultry manure, neem cake and rock phosphate on growth and yield of finger millet.

MATERIALS AND METHODS

Field experiment was conducted during *kharif* season of 2011 at Agricultural Research Station, Balajigapade, Chikkaballapur district. The experiment was conducted in a randomized complete block design (RCBD) with eleven treatment combinations and replicated three times. Well decomposed farmyard manure @ 10 t ha^{-1} for all the treatments and 7.5 t ha^{-1} for recommended practice (control) was applied 15 days before sowing and mixed thoroughly with soil. In the present investigation, liquid organic manure was produced in the bio-digester. Research Institute on Organic Farming at UAS, Bangalore came out with a bio-digester for the production of large quantities of bio-digester liquid organic manures (BDLM)

(Reddy and Shivanna, 2010). It was enriched with poultry manure or neem cake to raise the nitrogen level to 1 per cent. Further, it was enriched with rock phosphate to raise the phosphorus content to 0.66 per cent and kept for fermentation for 30 days after adding all the enriching materials. Bio-digester liquid manure and enriched bio-digester liquid manure were applied in two splits *ie* at 30 and 45 days after sowing. Treatment combinations tested were 10 t FYM + BDLM enriched with neem cake or poultry manure and/or rock phosphate and recommended practice (7.5 t FYM + 50-40-25 kg NPK/ ha) as control. Finger millet was sown @ 10 kg seeds per hectare in 30 cm wide rows using bullock drawn seed drill on 15th July 2011. Brush harrow was passed to cover the seeds. Thinning and gap filling was done 15 days after sowing, to ensure uniform plant population. Thinning was done to maintain single plant at 10 cm apart. Two hand weeding and two intercultivations were carried out in order to keep the plots free from weed competition and to form soil mulch.

Biometric observations were recorded on five randomly selected and labeled plants from each plot. The growth parameters *viz*, plant height, leaf area index (Watson, 1952) and dry matter production were recorded at 30, 60 and 90 DAS and at harvest. Besides productive tillers in 0.5 meter row length were also taken. From the net plot area earmarked for yield in each plot, earheads were harvested separately. Harvesting of earheads from the net plot was done followed by straw cutting at ground level. After threshing, grains were separated, cleaned and weighed. Later the grain yield per net plot was computed on hectare basis and expressed in kilograms per hectare as the formula given by Donald (1962).

RESULTS AND DISCUSSION

Effect of enriched bio-digester liquid manure on growth parameters of finger millet

Data pertaining to growth parameters of finger millet *viz.,* plant height, leaf area index (LAI), Number of tillers per 0.5 meter length and total dry matter accumulation as influenced by farmyard manure and enriched bio-digester liquid manure at different growth stages are furnished in Table 1and 2.

Plant height of finger millet at 30 DAS did not differ significantly among different treatments. However, at 60 DAS plant height in T_6 (FYM 10 t + BDLM enriched with poultry manure & rock phosphate equivalent to 60 kg N ha^{-1} and T_{10} (FYM 10 t + BDLM enriched with neem cake & rock phosphate equivalent to 60 kg N ha^{-1}) were on par with each other and significantly superior over all other treatments while lowest plant height was recorded in recommended practice (FYM 7.5 t + 50:40:25 kg NPK ha^{-1}). Same trend was followed at 90 DAS and at harvest. Similar result was obtained by Parasuraman *et al*. (2000), who reported that application of enriched FYM (750 kg ha^{-1}) recorded significantly higher plant height of finger millet over control.

Leaf area index at 30 DAS did not differ significantly among the different treatments. However, LAI ranged from 0.8 in T_3 (FYM 10t + BDLM enriched with poultry manure equivalent to 50 kg N ha^{-1}) to 0.99 in recommended practice. At 60 DAS, significantly highest LAI was noticed in T_6 which was on par with T_5 and T_{10} and superior than recommended practice. LAI increased steadily and reached maximum at 90 DAS. T_6 had significantly higher LAI as compared to recommended practice, however it was on par with treatment T_5 and T_{10}. This trend was maintained at harvest also. In the same line Govindappa (2003) reported that the high leaf area per plant was responsible for photosynthetic activity which in turn resulted in higher dry matter production.

The total dry matter at 30 DAS did not differ significantly among different treatments. Significantly higher total dry matter was observed in treatment T_6 which was found to be on par with treatment T_{10} while lower dry matter was observed in recommended practice. Same trend was followed at 90 DAS and at harvest. Similarly, Anil Kumar (2000) at Bangalore reported that application of 7.5 tonnes of compost per ha gave higher dry matter (27.39 g $hill^{-1}$) of finger millet as compared to without compost application (22.48 g $hill^{-1}$).

Tillers per 0.5 meter row length at 30 DAS did not differ significantly. Whereas 60 DAS, tillers produced by the application FYM 10 t + BDLM enriched with poultry manure & rock phosphate equivalent to 60 kg N ha^{-1} was on par with application of FYM 10 t + BDLM enriched with neem cake & rock phosphate equivalent to 60 kg N ha^{-1}. This trend was maintained at 90 DAS and also at harvest. Similarly, Adikant *et al*. (2009) reported that application of 7.5 tonnes of farmyard manure per hectare recorded highest grain yield (1888 kg ha^{-1}) and straw yield (3997 kg ha^{-1}) of kodo millet which was on

Table 1: Plant height and LAI of finger millet as influenced by the application of enriched biodigester liquid manure

Treatments	Plant height (cm)				Leaf Area Index			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	12.6	28.6	116.6	121.4	0.90	2.08	4.38	3.02
T_2	13.1	28.7	119.3	122.1	0.91	2.10	4.62	3.26
T_3	12.5	28.6	116.7	120.3	0.89	2.14	4.71	3.35
T_4	13.1	29.7	118.5	121.2	0.95	2.18	4.86	3.42
T_5	12.7	30.2	124.2	128.2	0.92	2.42	5.45	3.90
T_6	13.9	36.1	137.3	141.1	0.93	2.79	6.29	4.69
T_7	12.7	27.6	111.2	114.4	0.91	2.12	4.59	3.22
T_8	12.6	28.4	116.3	119.7	0.93	2.17	4.77	3.40
T_9	13.5	29.1	123.8	126.8	0.90	2.32	5.26	3.85
T_{10}	12.6	32.0	134.4	137.2	0.93	2.74	5.85	4.28
T_{11}	14.8	26.8	105.8	109.1	0.99	2.06	4.32	2.95
SEm ±	0.86	1.90	3.70	4.88	0.04	0.13	0.29	0.28
CD (p = 0.05)	NS	5.57	10.86	14.30	NS	0.38	0.85	0.81

Table 2: Effect of enriched bio-digester liquid manure on total dry matter accumulation (g plant^{-1}) and tiller numbers (per 0.5 m row length) of finger millet

Treatments	Total dry matter accumulation				Tiller numbers			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	1.76	7.25	20.15	27.80	6.80	8.30	10.53	10.53
T_2	1.84	7.50	20.44	28.74	6.50	8.32	10.66	10.66
T_3	1.72	8.11	21.69	31.12	6.13	9.46	10.40	10.40
T_4	1.91	8.96	22.91	32.66	6.97	9.56	10.53	10.63
T_5	1.88	10.02	27.01	35.89	6.30	10.60	11.27	11.27
T_6	1.91	11.40	31.44	43.08	6.71	13.63	17.33	17.33
T_7	1.84	7.83	20.82	30.74	6.33	9.21	10.21	10.21
T_8	1.86	8.72	22.03	31.91	6.83	9.32	10.11	10.11
T_9	1.78	9.13	25.64	33.45	6.60	10.25	10.93	10.93
T_{10}	1.95	10.98	29.31	40.96	6.61	12.03	16.47	16.46
T_{11}	2.26	6.92	18.34	25.74	7.47	8.14	10.33	10.34
SEm ±	0.19	0.43	1.31	1.98	0.49	0.52	0.54	0.54
CD (p = 0.05)	NS	1.27	3.92	5.93	NS	1.52	1.59	1.59

Table 3: Influence of enriched bio-digester liquid manure on grain, straw yield (kg ha^{-1}) and harvest index of finger millet

Treatment	Grain yield	Straw yield	Harvest index
T_1: 10t FYM + BDLME to 50 kg N ha^{-1}	2789	5300	0.35
T_2: 10t FYM + BDLME to 60 kg N ha^{-1}	2836	5531	0.34
T_3: 10t FYM + BDLM enriched with PM equiv. to 50 kg N ha^{-1}	2976	5538	0.35
T_4: 10t FYM + BDLM enriched with PM & RP equiv. to 50 kg N ha^{-1}	3287	6443	0.34
T_5: 10t FYM + BDLM enriched with PM equiv. to 60 kg N ha^{-1}	3461	6613	0.34
T_6 :10t FYM + BDLM enriched with PM & RP equiv. to 60 kg N ha^{-1}	3893	7228	0.35
T_7:10t FYM + BDLM enriched with NC equiv. to 50 kg N ha^{-1}	2931	5395	0.35
T_8: 10t FYM + BDLM enriched with NC & RP equiv. to 50 kg N ha^{-1}	3114	5981	0.34
T_9:10t FYM + BDLM enriched with NC equiv. to 60 kg N ha^{-1}	3300	6274	0.34
T_{10}:10t FYM + BDLM enriched with NC & RP equiv. to 60 kg N ha^{-1}	3849	7009	0.35
T_{11} Control: FYM 7.5 t + 50:40:25 kg NPK ha^{-1}	2741	5209	0.34
SEm ±	62.19	131.46	0.01
CD (p = 0.05)	183.46	387.82	NS

T_1: 10t FYM + BDLME to 50 kg N ha^{-1}, T_2: 10t FYM + BDLME to 60 kg N ha^{-1}, T_3: 10t FYM + BDLM enriched with PM equivalent to 50 kg N ha^{-1}, T_4:10t FYM + BDLM enriched with PM & RP equivalent to 50 kg N ha^{-1}, T_5: 10t FYM + BDLM enriched with PM equivalent to 60 kg N ha^{-1}, T_6: 10t FYM + BDLM enriched with PM & RP equivalent to 60 kg N ha^{-1}, T_7: 10t FYM + BDLM enriched with NC equivalent to 50 kg N ha^{-1}, T_8: 10t FYM + BDLM enriched with NC & RP equivalent to 50 kg N ha^{-1}, T_9: 10t FYM + BDLM enriched with NC equivalent to 60 kg N ha^{-1}, T_{10}:10t FYM + BDLM enriched with NC & RP equivalent to 60 kg N ha^{-1}, T_{11}: Control FYM 7.5 t + 50:40:25 kg NPK ha^{-1}

NS- Non significant, BDLME - Bio digester liquid manure equivalent, PM - Poultry manure (enriched BDLM to 1 % N), NC - Neem cake (enriched BDLM to 1 % N), RP - Rock phosphate (enriched BDLM to 0.66 % P_2O_5)

par with treatment receiving recommended dose of fertilizers (20:20:10 kg NPK ha^{-1}) (1590 and 3402 kg ha^{-1}, respectively).

Effect of enriched bio-digester liquid manure on grain and straw yield of finger millet

Application of FYM 10 t + BDLM enriched with poultry manure & rock phosphate equivalent to 60 kg N ha^{-1} produced highest grain yield (3893 kg ha^{-1}) and straw yield (7228 kg ha^{-1}) which was on par with application of FYM 10 t + BDLM enriched with neem cake & rock phosphate equivalent to 60 kg N ha^{-1} (3849 & 7009 kg ha^{-1}, respectively). While, lowest was obtained in recommended practice (2741 & 5209 kg ha^{-1}, respectively) (Table No.3). This was attributed to higher growth characters in turn improvement in these characters was due to slow and steady rate of nutrient release into soil solution to match the absorption pattern of finger millet. Similarly, at Ranichauri, supplying pine needle compost 3.75 t ha^{-1} with rock phosphate and gypsum gave significantly higher grain yield (2465 kg ha^{-1}) and straw yield (6380 kg ha^{-1}) of finger millet as compared to only 7.5 t pine needle compost ha^{-1} (1850 kg ha^{-1} and 5465 kg ha^{-1}, respectively) Anonymous (2004).

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