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A comprehensive study on population dynamics of microbial enrichment of Organic manures

K. Udhaya Kumar*[1], N. Jeyapandiyan[2], R. Susan Poonguzhali[3], R. Vinu Radha[4] and C. Jayapradha[5]

[1]Department of Agronomy,
[2]Department of Agricultural Meteorology and Climate Change,
[3]Department of Soil Science and Agricultural Chemistry,
[4]Department of Agricultural Microbiology,
[5]Department of Plant Pathology, Karunya Institute of Technology and Sciences, Coimbatore 641 114, T.N., India

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ABSTRACT

An experiment was conducted in Department of Agriculture, Karunya Institute of Technology and Sciences, Coimbatore to study the population dynamics of microbially enriched organic manures and their nutrient composition. Organic manures such as vermicompost, FYM, and coir pith compost were enriched with the lignite based microbial strains of *Rhizobium leguminosorum*, *Bacillus megatherium* and its combined inoculum at a rate of 1 kg per ton of manure and its moisture content was maintained at 50 per cent and incubated for 180 days. After their enrichment, the microbial load in the organic manures was enumerated using the standard plate count technique. The microbial results revealed that the maximum microbial population was attained on the 90th day after enrichment. The total microbial population in combined bio fertilizers (*Rhizobium* and Phosphobacteria) inoculated vermicompost was high during the initial phases and then total microbial population declined towards the end. Among the enriched organic manures, the highest population was observed in combined microbial strains enriched with vermicompost (6.52 $\log_{10}$ CFU g^{-1}) whereas, after 3 months the enriched organic manure shows the very less population density.

Key words: *Bio-fertilizer, Organic manures, Enrichment, Population*

Introduction

The use of chemical fertilizers and organic manure has both positive and negative effects on plant growth and the soil. Chemical fertilizers are relatively inexpensive, have high nutrient contents, and are rapidly taken up by plants. However, the use of excess fertilizer can result in a number of problems, such as nutrient loss, surface water, groundwater contamination, soil acidification or basification, reductions in useful microbial communities, and increased sensitivity to harmful insects (Chen, 2006). Organic manure has a number of shortcomings, including low nutrient content, slow decomposition, and different nutrient compositions depending on its organic materials, compared to chemical fertilizers. However, organic manure has multiple benefits due to balanced supply of nutrients, including micronutrients, increased soil nutrient availability due to increased soil microbial activity, the decomposition of harmful elements, soil structure improvements and root development, and increased soil water availability. Maintaining soil fertility as well as the sustainability of crop production, by using

([1,2,3,4,5]Assistant Professor)

different organic manures viz., vermicompost, green compost, farmyard manure (FYM), has attracted the farmers to replace the use of chemical fertilizers (Barassi *et al.,* 2007; Baker and Mostafa, 2011; Geetha and Balamurugan, 2011). Thus, there is an urgent need to generate organic farming practices using vermicompost, FYM, coir pith and microbial fertilizers, *etc*. Bio fertilizers were found to have a positive contribution to soil fertility resulting in an increase in crop yield without causing any type of environmental wastes or soil hazards. Significant improvements in growth, yield and quality of vegetables with different bio fertilizer applications have been reported on various crops.

Most of the organic manures are very low in nutrient contents, which are not sufficient to meet the nutritional requirement of the crops, especially when inorganic fertilizers are not applied (Manna *et al.*, 2001). Under such circumstances, fortification of organic manures and composts with permitted additives like rock phosphate, beneficial microbial cultures, and neem cake is a feasible option for nutrient supplementation in organic food production. The enrichment of the organic manures with beneficial microbial cultures will further contribute to the enhancement of N and P contents through nitrogen fixation and phosphate solubilization. Hence, the enriched organic manures and their combination provide an ideal nutrition strategy for the crop. The duration of incubation after enrichment is an important aspect. Loss of released nutrients can be determined by analysing the population dynamics of enriched microbes in the organic manures at regular intervals.

With a view to identifying a better nutrient management technique which is economical as well as ecologically efficient, the present investigation was conducted at the Department of Agriculture, Karunya Institute of Technology and Sciences, to understand the population dynamics of microbially enriched organic manures at different time intervals.

Materials and Methods

For organic manures (Vermicompost, FYM and coir pith compost) enrichment, lignite based microbial cultures (*Rhizobium leguminosorum* and *Bacillus megatherium*) were collected from Tamil Nadu Agricultural University, Coimbatore. The enrichment of organic manures and biofertilizers were added at one kg per tonnes of manure. The microbial population was estimated at different periods viz 0, 30, 60, 90, 120, 150, and 180th days after inoculation to determine the period at which the maximum attainment of the microbial population can be achieved in the enriched organic manures. The enumeration of *Rhizobium* and Phosphobacteria was done by serial dilution technique and standard plate count technique using YEMA medium and pikovskaya's medium respectively.

Statistical analysis

All data were statistically analyzed in Microsoft Excel and add in with XLSTAT version 2016.04.325250 (XLSTAT, 2010). Significant differences among the treatments were statistically analyzed using analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) at significance level of $p < 0.05$.

Results

The enrichment of organic manures such as vermicompost, FYM, and coir pith compost was done in the present study by inoculating the bio fertilizer inoculants, *R. leguminosorum* and *B. megatherium*. The results revealed that, an increase in the population of inoculated organisms in organic manures from 0th day to 90th day after inoculation. After 90th day, the counts were decreased after 3 months due to nutrient leach and acid production.

The maximum population of inoculated organisms were observed from 30th day to 90th after inoculation in all three organic manures. The population of combined treatment of symbiotic nitrogen-fixing bacteria *R. leguminosorum* and phosphate solubilizing bacteria *B. megatherium* was highest on the 90th day in enriched vermicompost (6.63 $\log_{10}$ CFU g^{-1}), followed by FYM (6.32 $\log_{10}$ CFU g^{-1}), and coir pith compost (5.85 $\log_{10}$ CFU g^{-1}) respectively. Whereas, the individual inoculum treated organic manures shows the population density of about (3.31 $\log_{10}$ CFU g^{-1}) in vermicompost, followed by FYM (3.52 $\log_{10}$ CFU g^{-1}), and coir pith compost (3.31 $\log_{10}$ CFU g^{-1}) respectively. Compared to this, the population at zero day of enrichment in vermicompost (1.10, 1.82 and 3.91 $\log_{10}$ CFU g^{-1}, respectively), FYM (1.09, 1.76 and 1.93 $\log_{10}$ CFU g^{-1} respectively), and coir pith compost (1.04, 1.63 and 1.85 $\log_{10}$ CFU g^{-1} respectively). The highest population of phosphate solubilizing bacteria was recorded in all the three enriched organic manures from 30th day to 90th day after inoculation. Among the three enriched organic ma-

nures, the highest population was recorded in enriched vermicompost, while the lowest population was observed in coir pith compost. The population of microorganisms in the enriched manures slightly decreased on 120th to 180th day after enrichment in all the substrates compared to 90th day.

Discussion

Biofertilizers were found to have a positive contribution to soil fertility resulting in an increase in crop yield without causing any type of environmental wastes or soil hazards. Significant improvement in growth and yield and quality of vegetables with different bio fertilizer applications have been reported on various crops. The organic manures as well as bio fertilizers greatly influence the growth of plants and various physiological parameters. The influence of organic manures on leaf numbers like LAI and DMP, was superior over inorganic fertilizer application (Subbarao and Ravisankar, 2001).

Vermicompost is potential organic manure and a rich source of major and minor nutrients to plants. According to Phule (1993), the application of vermicompost in sugarcane resulted in a higher yield significantly. The findings of the present study reveal that, enrichment with bio fertilizers (*Rhizobium* and phosphobacteria), enhances the microbial population and enzyme activity in the fresh raw vermicompost. The application of enriched vermicompost to the agriculture field may help to build and sustain more fertility when compared to fresh vermicompost. Likewise, Rajalekshmi and his co-workers (1997) got better yielding in Bhindi when plants were treated with *Azospirillum*, FYM, and inorganic fertilizers. The results of the present study clearly showed the superiority of microbial enriched FYM and coir pith had more microbial population density when compared to the farmyard manure alone. However, compared to FYM and coir pith manure, the microbial load was increased in the enriched vermicompost manure for up to 3 months. After 3 months, the microbial load was reduced to 30 per cent.

The organic manures when used as a carrier material for bio fertilizers supported the survival rate for more than one year (Raja sekar and Karmegam, 2010). The survival and increase of microbial population were observed in enriched manures of vermicompost, FYM and coir pith. The findings of the present study also showed similar results, where the enriched manures of vermicompost, FYM and coir pith served as a substrate for the survival and viability of the bio fertilizer inoculants for sustainable pulse production.

Conclusion

The results of the present study clearly brought out the maximum population attained in combined treatment up to 90 days in enriched vermicompost due to the enzymatic activities as well as the micro-

Table 1. Microbial load in vermicompost, FYM, and coir pith after microbial enrichment for different period (in days)

Organic manures	Enriched withmicrobial strains	Microbial population (log_{10} CFU g^{-1} at different time interval (in days)						
		0th day	30th day	60th day	90th day	120th day	150th day	180th day
Vermicompost	*R. leguminosorum*	1.10	2.13	3.10	3.31	2.20	2.10	1.12
	B. megatherium	1.82	4.20	5.23	5.40	4.12	4.09	1.93
	R. leguminosorum + *B. megatherium*	3.91	6.12	6.52	6.63	5.13	5.09	3.37
FYM	*R. leguminosorum*	1.09	2.08	2.98	3.52	2.23	2.10	1.10
	B. megatherium	1.76	3.12	4.25	4.91	3.02	2.98	2.56
	R. leguminosorum + *B. megatherium*	1.93	5.43	6.12	6.32	4.98	3.92	3.02
Coir pith compost	*R. leguminosorum*	1.04	1.92	2.15	3.31	3.10	2.95	2.36
	B. megatherium	1.63	2.95	3.57	4.29	3.92	3.51	2.59
	R. leguminosorum + *B. megatherium*	1.85	4.52	5.28	5.85	4.26	3.98	3.02
	SEd	0.06	0.09	1.00	1.32	1.26	1.10	1.09
	CD	1.00	1.13	1.20	1.34	1.52	1.40	1.43

*Values represent mean of three replications shows significant results at 5% level of probability

bial population. Since the organisms inoculated are heterotrophs, their activities in the organic manures lead to the conversion of unavailable form to the available form of nutrients (mineralization). So, the enrichment of manures with beneficial microflora contributed a significant improvement in the nutrient concentration of all organic manures.

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References

Baker, A. and Mostafa, G. G. 2011 Effect of bio-and chemical fertilizers on growth, sepals yield and chemical composition of *Hibiscus sabdariffa* at new reclaimed soil of South Valley area. *Asian J. of Crop Sci.* 3(1) : 16-25.

Barassi, R., Sueldo, J., Creus, C.M., Carrozzi, L. E., Casanovas, E. M. and Pereyra, M. A. 2007. *Azospirillum* spp., a dynamic soil bacterium favourable to vegetable crop production. *Dynamic Soil, Dynamic Plant*. 1(2) : 68-82.

Chen and Jen-Hshuan, 2006 The combined use of chemical and organic fertilizers and/or biofertilizer for crop growth and soil fertility. In; *International workshop on sustained management of the soil-rhizosphere system for efficient crop production and fertilizer use*, vol. 16, no. 20 : 1-11. Land Development Department Bangkok Thailand (2006).

Geetha and Balamurugan, P. 2011. Organic seed pelleting in mustard. *Res. J. Seed Sci.* 4(3) : 174-180.

Manna, M. C., Ghosh, P. K., Ghosh, B. N. and Singh, K.N. 2001. Comparative effectiveness of phosphate-enriched compost and single superphosphate on yield, uptake of nutrients and soil quality under soybean-wheat rotation. *J. Agril. Sci.* 137 : 45-54.

Raja Sekar, K. and Karmegam, N. 2010. Earthwormcasts as an alternate carrier material for biofertilizers: assessment of endurance and viability of *Azotobacter chroococcum, Bacillus megaterium* and *Rhizobium leguminosarum*,. *Scientia Hort.* 124(2) : 286-289.

Subbarao, T.S.S. and Ravisankar, C. 2001. Effect of organic manures on growth and yield of brinjal. *National seminar on changing scenario in the production system of horticultural crops*. *Aug 28-30.* South Indian Horticulture, Coimbatore. pp. 288-289.

Phule, K.G. 1993. Effect of vermiculture farming in Sugarcane. *Proceedings of Congress on Traditional Science and Technologies of India. 28 Nov - 3 Dec,* Bombay, pp.6-12.

Rajalekshmi, K., Pushkala, S. and P. Padmaja, P. 1997. Hydrolic characters and available nutrients in oxisol as influenced by vermicompost / vermiculture. *Proceedings Ninth Kerala Science Congress,* January 1997, Science and Technology and Environmental Department, Thrissur, pp. 118-120.

Xlstat, 2010. Xlstat. Add in soft SARL, Paris. http://www.xlstat.com.