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Short communication

Evaluation of different organic manure mixtures in vegetable amaranth cultivation

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ABSTRACT

An investigation was conducted during 2009-2011 at College of Agriculture, Vellayani, to develop bio-organic composite manures containing at least 3%N, with N:K ratio of 1:0.5, and to evaluate the effect of these manures on growth and productivity of vegetables. The investigation comprised three separate experiments, namely, formulation and quality evaluation of bio-organic composite manures, mineralization of bio-organic composite manures, and, crop response study. Amaranth (*Amaranthus tricolor*) was raised as a test crop for the study. Organic sources used in the preparation of bio-organic composite manures were:coir pith compost, poultry manure, neem cake, ground nut cake, ash, rock dust and microbial consortium. Five composite organic manures, satisfying the selection criteria (3%N, N:K ratio of 1:0.5), were identified for further investigation. Results of the crop response study revealed that among the bio-organic composite manures used, maximum yield was obtained under poultry manure (50g) + ground nut cake (30g) + rock dust (19g) + microbial consortium (1g), and this was on par with (i) coir pith compost (50g) + ground nut cake (35g) + ash (15g), and, (ii) poultry manure (50g) + ground nut cake (30g) + rock dust (20g).

Key words: Bio-organic composite manure, mineralization study, organic sources

Organic agriculture is a holistic production management system that promotes and enhances agro-ecosystem health including bio-diversity, biological cycles and soil biological activity. Organic manures improve physical, chemical and biological properties of the soil. Soils managed with organic amendments generally have larger microbial populations than those managed with mineral fertilizers. Thus, incorporation of organic amendment to soil promotes microbial activity (Balasubramanian *et al*, 1972). One of the basic principles of soil fertility management in organic systems is dependence of plant nutrition on biologically derived nutrients. Animal manures, oil cakes, biofertilizers and by-products of agro-industries are some potential sources of nutrients in organic farming. Organic farming is essential for producing quality vegetables devoid of toxic residuals. In view of all these aspects, it is worthwhile to develop technologies for developing organic manures with higher nutrient status, better nutrient-release and ideal nutrient-ratio suitable for vegetable crops. Results of such investigations may help develop bio-organic composite manures with safe C:N ratio containing at least 3% N, and N:K ratio of 1:0.5 (an ideal ratio for most vegetables).

The investigation was carried out at College of Agriculture, Vellayani, during 2009-2011 and comprised three separate experiments: (1) Formulation and quality evaluation of bio-organic composite manures, (2) Mineralization study of bio-organic composite manures, and (3) Crop response study.

In the first experiment, a study was conducted in the laboratory during January 2010 - January 2011. Coir pith compost, poultry manure, neem cake, ground nut cake, ash, rock dust and microbial consortium (Sivaprasad, 2011; Sheeja *et al*, 2012 and 2013) were used as sources for preparing bio-organic composite manures. Raw materials were mixed in different proportions to obtain various organic manure mixtures. Sixteen organic manure mixtures were prepared as per treatments presented in Table 1. The experiment was laid out in Completely Randomized Design, with 16 treatments and 2 replications. Composite organic manures showing at least 3% N and N:K ratio of 1:0.5, were selected for further study. Five mixtures (OM3, OM5, OM9, OM11, 0M13) satisfying all selection criteria (3%N and N:K- 1:0.5) were identified for further investigation.

Coir pith compost was prepared as per the following procedure: Materials required: Coir pith 1 tonne, urea 5 kg, mushroom (*Pleurotus*) spawn 1.5kg.

Table 1. Components used in organic manure production

Treatment	Organic sources (weight in g)						
	Coir pith compost	Poultry manure	Groundnut cake	Neem cake	Rock dust	Ash	Microbial consortium
OM1	50	_	35	_	15	_	_
OM2	50	_	20	20	10	_	_
OM3	50	_	35	_	_	15	_
OM4	50	_	20	20	_	10	_
OM5	_	50	30	_	20	_	_
OM6	_	50	20	15	15	_	_
OM7	_	50	20	20	_	10	_
OM8	_	50	30	_	_	20	_
OM9	50	_	36	_	13	_	1
OM10	50	_	22	22	5	_	1
OM11	50	_	35	_	_	14	1
OM12	50	_	22	22	_	5	1
OM13	_	50	30	_	19	_	1
OM14	_	50	22	17	10	_	1
OM15	_	50	30	_	_	19	1
OM16	_	50	22	22	_	5	1

Select a shaded place of 5x3m dimension and level it after removing weeds. First, spread 100 kg coir-pith uniformly. Spread 300g (one bottle or cover) of Pleurotus spawn on this and cover it with a second layer of 100kg coir pith. On the surface of the second layer, spread 1kg urea uniformly. Repeat this sandwiching process of one layer coir pith with spawn, followed by another layer of coir pith with urea, up to 1m height. Sprinkle water, if necessary, to keep the heap moist. Allow the heap to decompose for the month. The coir pith is converted into good manure after about 30-40 days.

In the second experiment, mineralization study was conducted in pots during January 2011 to June 2011. The objective of the study was to assess nutrient release pattern from different organic manure mixtures. The experiment was laid out in Completely Randomized Design, with eight treatments and three replications. Five selected mixtures, along with Kerala Agricultural University Package of Practice (KAU, package of practive) [100:50:50 kg/ha $N:P_2O_5:K_2O$ (50: 50: 50 kg/ha $N:P_2O_5:K_2O$ applied as basal and 50 kg/ha N applied as top dressing after each harvest)], Kerala Agricultural University *Ad hoc* organic Package of Practice (cow urine @ 500tha^{-1} (Kerala Agricultural University, 2009)) and absolute Control formed the eight treatments. These composite manures were applied as N equivalent basis of 100kgN ha^{-1} (Kerala Agricultural University, 2007) for the test crop, amaranth. The soil, containing composite manures, was filled in pots of uniform size (30x30cm^2). Sampling was done at monthly interval for a period of six months after incubation.

Table 2. Nutrient content of organic manure mixtures used

Treatment	N (%)	P (%)	K (%)
OM1	1.79	0.61	0.66
OM2	1.79	0.36	0.77
OM3	3.25	0.87	1.44
OM4	1.79	0.67	1.02
OM5	3.14	1.04	1.32
OM6	2.02	1.24	1.14
OM7	2.63	1.19	1.96
OM8	2.24	1.12	1.70
OM9	3.53	0.27	1.72
OM10	2.29	0.17	2.32
OM11	3.19	0.26	1.24
OM12	2.91	0.24	1.58
OM13	3.08	0.39	0.88
OM14	2.13	0.33	1.24
OM15	2.97	0.45	0.66
OM16	2.24	0.38	0.76

Crop response study was conducted with eight treatments and three replications using vegetable amaranth as the test crop. Treatments were same as the mineralization study. The experiment was laid out in Completely Randomized Block Design.

Treatments:

T_1 - OM3 (coir pith compost 50g + ground nut cake 35g + ash 15g)

T_2 - OM5 (poultry manure 50g + ground nut cake 30g + rock dust 20g)

T_3 - OM9 (coir pith compost 50g + ground nut cake 36g + rock dust 13g + microbial consortium 1g)

Table 3. Effect of various treatments on available nitrogen, phosphorus and potassium status in soil (kg ha^{-1})

Treatment	Nitrogen			Phosphorus			Potassium		
	1MAI	3MAI	6MAI	1MAI	3MAI	6MAI	1MAI	3MAI	6MAI
T1	238.34	357.51	314.32	131.51	98.47	80.74	174.35	147.28	102.97
T2	280.15	351.24	308.94	138.39	92.74	71.23	124.88	108.64	86.35
T3	313.60	376.32	314.68	125.85	93.15	78.08	122.64	126.56	92.22
T4	319.87	357.51	332.02	119.51	88.48	52.43	180.88	129.92	101.89
T5	363.62	329.87	299.14	131.91	86.51	70.00	128.43	100.80	83.78
T6	288.52	319.87	298.88	107.16	77.26	76.19	156.24	151.20	115.83
T7	357.51	313.60	299.76	128.63	98.57	68.60	138.32	122.08	89.55
T8	288.52	301.23	222.52	98.03	65.54	66.13	105.28	99.12	66.91
SE	5.63	10.27	4.31	1.95	1.76	2.73	5.56	5.37	3.09
CD *(P=0.05)*	16.87	30.81	12.93	5.84	5.27	8.19	16.68	16.11	9.27

MAI - Months After Incubation

T_4 - OM11 (coir pith compost 50g + ground nut cake 35g + ash 14g + microbial consortium 1g)

T_5 - OM13 (poultry manure 50g + ground nut cake 30g + rock dust 19g + microbial consortium 1g)

T_6 - Kerala Agricultural University *Ad hoc* Organic Package of Practice

T_7 - Kerala Agricultural University Package of Practice

T_8 - Soil alone

Sixteen different organic manures were prepared and N, P, K content in these was analyzed. Data presented in Table 2 reveal that OM9 recorded maximum nitrogen content (3.53%), OM6 registered maximum phosphorus content (1.24%) while OM10 recorded maximum potassium content (2.32%). Criteria fixed for manure selection were: a minimum of 3% N, and N:K ratio of 1:0.5. OM3, OM5, OM9, OM11 and OM13 registered N content over 3%, and N:K ratio of over 1:0.5. Better nitrogen content in these selected manures is due to presence of ground-nut cake and nitrogen fixing organisms present in the microbial inoculant used in preparation of the manures.

Available N, P and K content of soil as influenced by various bio-organic composite manures was analyzed and results are presented in Tables 3,4 and 5. During the initial stage of mineralization, OM13 recorded significantly higher available N content (363.62kg ha^{-1}) compared to that in all other treatments. At 3 and 4 months of incubation, OM9 recorded increased N content (376.32kg ha^{-1} and 357.42kg ha^{-1}, respectively) which was significantly higher from other treatments. At 5 and 6 months of incubation, highest N content was recorded in OM11 (342.55 and 332.02 kg ha^{-1}, respectively) which was significantly superior to that in all other treatments. Initial increase in available N observed in

Table 4. Effect of various treatments on yield and yield attributes of amaranth

Treatment	Leaf wt (g plant^{-1})	Stem wt (g plant^{-1})	Yield (t ha^{-1})
T1	51.89	22.96	12.48
T2	46.32	23.59	11.65
T3	41.72	20.16	10.31
T4	42.04	22.12	10.69
T5	53.23	23.32	12.76
T6	40.53	17.22	9.63
T7	44.33	20.73	10.85
T8	22.69	12.32	5.84
SE	1.52	1.21	0.566
CD *(P = 0.05)*	4.61	2.78	1.20

OM3, OM11 and OM13 was perhaps due to mineralization of the nutrients in organic manures. This mineralization occurred due to safe C:N and C:P ratios of the manures. Later, reduction in mineralization was observed at 2 months of incubation; thereafter again, an increase was observed. With OM5 and OM9, available N content increased gradually up to three months of incubation.

Available phosphorus content was highest in OM5 at one and two months after incubation (138.39 and 125.35kg ha^{-1}, respectively). At one month after incubation, OM5 was significantly superior to all other treatments, and, at two months after incubation it was on par with OM3. At 3, 4, 5 and 6 months after incubation, OM3 recorded maximum P content (98.47, 97.77, 84.15 and 80.74kg ha^{-1}, respectively). For all the manures used, availability was high during the first month after mineralization, and the content declined gradually thereafter.

Available K_2O content at one month of incubation was highest in OM11 (180.88kg ha^{-1}) and was significantly superior to all other treatments except OM3. The content of K_2O at 2 months after incubation and 3 months after

incubation was significantly higher in OM3 added soil (163.89kg ha^{-1} and 147.28kg ha^{-1}, respectively). At four and five months of incubation, OM3 was significantly superior to all other manures. At six months after incubation, manures showed a decline in available K_2O content. Application of farmyard manure, poultry manure and sugarcane filter cake, alone or in combination with chemical fertilizers, improved soil organic C, total N, P, and K status compared to soils that received chemical fertilizers alone (Kulvinder *et al*, 2005).

Results from crop response study given in Table 6 show that OM13 registered highest yield (12.76t ha^{-1}), which was on par with OM3 (12.48t ha^{-1}) and OM5 (11.65t ha^{-1}), and was significantly superior to all other treatments. Yield is a function of leaf weight and stem weight. OM3, OM5 and OM13 recorded higher leaf and stem weights, which cumulatively resulted in better yield. OM3, OM5 and OM13 recorded higher plant height compared to OM9 and OM11. This must have resulted in better leaf growth and higher stem weight. Gianquinto and Borin (1990) observed increase in plant growth and yield in tomato plants with addition of organic manures. Awodun (2007) reported poultry manure application in fluted pumpkin increased number of leaves and branches, length of internode compared to NPK fertilizers. The same was reported by Jose *et al* (1988).

This study shows that application of bio-organic composite manure (prepared by mixing poultry manure, ground-nut cake, rock-dust and microbial consortium) can produce 12.76 t ha^{-1} of vegetable amaranth.

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