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Research Article

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Influence of poultry composts on growth and yield attributes of sunflower

M. PRASANTHRAJAN, P. DORAISAMY, M. PANDIYAN AND K.P. SIVAKUMAR

ABSTRACT : A field trial was conducted with twelve treatments to test the effectiveness of poultry - carbonaceous wastes compost on the soil properties, growth and yield attributes of sunflower (Var – CO1). Application of compost improved the soil fertility by adding humus and nutrients. Compost along with 100% (60: 45: 45 kg NPK ha^{-1}) and 75% (45: 33: 33kg NPK ha^{-1}) recommended NPK increased the growth and yield of sunflower. Among the composts (Poultry droppings and coir pith, poultry droppings and paddy straw, poultry droppings and coir pith with rock phosphate), the coir pith, rock phosphate mixed poultry compost performed well. The coir pith and rock phosphate added poultry compost along with recommended levels of NPK recorded higher yield which was at par with the results of coir pith mixed poultry compost along with 75 per cent levels of recommended N, P and K. Compost application improved the crop yield, soil fertility status and saved 25 per cent of fertilizer.

KEY WORDS : Poultry waste, Compost, Sunflower yield, Soil properties

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INTRODUCTION

In the poultry industry, layer hen and broiler keeping systems were developed during the past years, aiming at the reduction of negative environmental impacts, especially of NH_3 emissions into atmosphere and to make easier poultry manure management. Advanced technologies are not being adapted in most of the layer and broiler poultry farms, but simple and efficient management systems can significantly reduce ammonia loss and odour emissions. The composting of organic wastes has been defined as a controlled microbial aerobic decomposition process. The main products of aerobic composting are CO_2, water, mineral ions and stabilized organic matter, often called humus. Well-composted organic matter is traditionally used as a source of nutritional elements and/or soil conditioner directly in the field. For centuries, organic waste streams have been composted. More recently composting has been used as a management tool to stabilize large quantities of livestock and poultry manure that might otherwise generate NH_3 odours and propagate flies. In earlier studies, it was reported that application of compost increased the dry matter production, yield and other physiological attributes of groundnut crop (Udayasoorian *et al.*, 1999) and cowpea (Prasanthrajan and Kannan, 2007). A sustainable agricultural system must be economically sound, socially acceptable and environmentally compatible. The challenge of sustainable agricultural research and education programme is to develop

MEMBERS OF RESEARCH FORUM

Address of the Correspondence :
M. PRASANTHRAJAN, Agricultural Research Station, Virinjipuram, VELLORE (T.N.) INDIA
Email: prasanth_phd@yahoo.co.in

Address of the Coopted Authors :
P. DORAISAMY, M. PANDIYAN AND K.P. SIVAKUMAR, Department of Environmental Science, Tamil Nadu Agricultural University, COIMBATORE (T. N.) INDIA

systems that meet these three inter connected goals. A sustainable approach requires producers to substitute management, scientific information and on farm resources for the purchase inputs on which their farming enterprises currently depend. Some of those purchased inputs are pesticides and fertilizers. Over the year a number of research projects have focused on the ability of compost to reduce the need for those inputs. Taking into consideration the pollution due to NH_3 volatilization from poultry droppings and the problems pertaining to the disposal of carbon rich waste materials *viz.*, sawdust, coir pith, paddy straw, leaf litter and paper waste, the present investigation was undertaken.

EXPERIMENTAL METHODS

Field experiment was conducted at farmer's field, Narasipuram village, Coimbatore, Tamil Nadu. The sunflower variety CO-1 with 110 days duration was raised as test crop. Twelve treatments were assigned to experimental units at random. The size of each plot was 18 m^2. The treatments followed are, T_1 - Absolute control, T_2 - 100% NPK, T_3 - FYM @ 12.5 ha^{-1} + 100% NPK, T_4 - Compost mix (Poultry droppings + coir pith), T_5 - Compost mix (Poultry droppings + paddy straw), T_6 - Compost mix (Poultry droppings + coir pith + Rock phosphate), T_7 - Compost mix (Poultry droppings + coir pith) + 100% NPK, T_8 -Compost mix (Poultry droppings + paddy straw) + 100% NPK, T_9 - Compost mix (Poultry droppings + coir pith + Rock phosphate) + 100% NPK, T_{10} -Compost mix (Poultry droppings + coir pith)+ 75% NPK, T_{11} - Compost mix (Poultry droppings + paddy straw) + 75% NPK, T_{12}- Compost mix (Poultry droppings + coir pith + Rock phosphate) + 75% NPK. Compost mix @ 6 t ha^{-1} and fertilizer (100%) @ 60: 45: 45 kg NPK ha^{-1} were followed in the field experiment. The experiment was laid out in a Randomized Block Design with three replications. Soil and plant samples were collected at vegetative, flowering and harvest stages, processed and analyzed by following standard analytical methods.

Plant height was measured in cm, from the ground level to the tip of the growing point. For dry matter production, the plants were randomly selected and removed at vegetative, flowering and harvest stages. The samples were first air dried in the shade and then oven dried at 60°C. The samples were weighed and expressed in kg ha^{-1}. Yield was recorded from the tagged plants and expressed in kg ha^{-1}. Pod diameter was measured and expressed in cm. The number of seeds per pod was counted and the mean value was calculated. The data obtained from the present investigation were subjected to statistical analysis following the methods of Snedecor and Cochran (1967) and Panse and Sukhatme (1985).

EXPERIMENTAL RESULTS AND ANALYSIS

Application of compost significantly enhanced the organic carbon content of the soil throughout the growth of sunflower. Addition of compost (20 - 200 g pot^{-1}) improved soil chemical (increased total N, total C and CEC), physical

Table 1 : Effect of poultry composts and different levels of fertilizer on changes in pH, EC and organic carbon content of the sunflower grown soil

Treatments	pH			EC (dS m^{-1})			Organic carbon (%)		
	Vegetative stage	Flowering stage	Harvest stage	Vegetative stage	Flowering stage	Harvest stage	Vegetative stage	Flowering stage	Harvest stage
T_1	7.30	7.25	7.23	0.14	0.12	0.12	0.55	0.44	0.36
T_2	7.92	7.85	7.42	1.33	1.07	0.64	0.80	0.62	0.32
T_3	7.96	7.87	7.40	1.37	1.12	0.83	0.81	0.65	0.37
T_4	8.02	7.83	7.38	1.75	1.25	0.84	0.83	0.66	0.39
T_5	8.03	7.84	7.32	1.79	1.11	0.82	0.82	0.59	0.41
T_6	8.10	7.80	7.31	1.82	1.14	0.84	0.84	0.65	0.43
T_7	7.92	7.69	7.22	1.74	1.06	0.65	0.85	0.67	0.44
T_8	7.91	7.62	7.18	1.73	1.02	0.64	0.88	0.65	0.42
T_9	7.93	7.65	7.21	1.70	0.98	0.54	0.93	0.68	0.43
T_{10}	7.96	7.75	7.33	1.83	1.12	0.73	0.82	0.69	0.44
T_{11}	7.99	7.74	7.21	1.76	1.08	0.69	0.87	0.65	0.45
T_{12}	7.92	7.72	7.26	0.74	1.02	0.66	0.87	0.62	0.43
S.E. $\pm$	0.632	0.496	0.691	0.163	0.097	0.066	0.082	0.062	0.045
C.D. (P=0.05)	NS	NS	NS	0.338	0.201	0.137	NS	NS	NS

T_1 - Absolute control, T_2 - 100% NPK, T_3 - FYM @ 12.5 ha^{-1} + 100% NPK, T_4 - Compost mix (1), T_5 -Compost mix (2), T_6 - Compost mix (3), T_7 -Compost mix (1) + 100% NPK, T_8 -Compost mix (2) + 100% NPK, T_9 -Compost mix (3) + 100% NPK, T_{10} -Compost mix (1) + 75% NPK, T_{11} -Compost mix (2) + 75% NPK, T_{12} - Compost mix (3) + 75% NPK NS= Non-significant

(decreased particle density) and biological (increased soil respiration rates) properties. Application of coir compost improved the physical characteristics like infiltration rate, total porosity and hydraulic conductivity in red soil.

The pH of the experimental soil was ranged from 7.42 to 8.25 during vegetative stage of crop growth. As the crop advanced to maturity, pH decreased gradually and ranged from 7.28 to 7.52 during maturity (Table 1). The reduction in soil pH could be ascribed to the significant build up in organic matter content of the soil under compost applied treatments and subsequent release of organic acids. The buffering capacity of the soil and organics added might have contributed to the reduction in pH. A number of workers have elucidated the influence of added organics in reducing the pH (Mahimairaja *et al*., 1995). The electrical conductivity of the soil showed a decreasing trend from vegetative stage to harvest. The organic matter enables the release of plant nutrients and makes them available to plant when applied to soil. It is even capable of increasing the efficiency of added plant nutrients when applied with inorganic fertilizers. Compost which is stabilized and partly decomposed organic matter is found to improve the soil structure. Soil biological properties were improved because of the addition of compost obtained from poultry droppings and coir pith. Available N, P and K content was high during the initial vegetative stage and decreased with the advancement of crop growth. In general, plot applied with coir pith + poultry compost along with 100 per cent recommended NPK recorded highest N, P and K content during harvest stage. Soil applied with rock phosphate mixed compost recorded high phosphorus content than other treatments. Among the composts applied, coir pith mixed poultry compost performed well than the paddy straw mixed poultry compost (Table 2).

The sunflower crop showed steady increase in height from vegetative stage to maturity. More quantity of the fertilizer application resulted in more crop growth. The pest infestation in sunflower crop was comparatively less in compost applied plot when compared to control. The recommended N, P and K along with coir pith added poultry compost @ 6 t ha^{-1} had a pronounced effect on plant height, plant girth, grain yield, straw yield and 100 grain weight. The treatments T_9, T_7, T_{12}, T_{10} performed well than other treatments. Coir pith mixed poultry compost along with 75 per cent recommended level of N, P and K had on par results with 100 per cent level of N, P and K along with compost. During the vegetative stage, T_7 recorded the maximum plant height (46 cm). There was a tremendous increase in plant height during the flowering stage. The plant height ranged from 152 to 194 cm during the harvest stage. The highest plant height was recorded in T_9 (194 cm) during the harvest stage (Table 3). There was a considerable amount of dry matter accumulation during the vegetative stage. The dry matter production ranged from 354 kg ha^{-1} to 646 kg ha^{-1} during vegetative stage. During the harvest stage, it ranged from 3620 to 7916 kg ha^{-1}. Highest dry matter accumulation recorded in T_9 (7916 kg ha^{-1}) followed by T_7 (7812 kg ha^{-1}). The grain yield of the sunflower ranged from 890 to 1915 kg ha^{-1} and the stalk yield varied from 2420 to 4835 kg ha^{-1} (Table 4). The maximum grain yield (1915 kg ha^{-1}) was recorded in T_9 followed by T_7 (1912 kg ha^{-1}). The maximum stalk yield recorded was in T_9

Table 2: Effect of poultry composts and different levels of fertilizer on changes in available NPK content of sunflower grown soil

Treatments	Available nitrogen (kg ha^{-1})			Available phosphorus (kg ha^{-1})			Available potassium (kg ha^{-1})		
	Vegetative stage	Flowering stage	Harvest stage	Vegetative stage	Flowering stage	Harvest stage	Vegetative stage	Flowering stage	Harvest stage
T_1	202	191	182	10.0	9.0	8.6	392	378	352
T_2	223	208	200	15.2	14.0	13.2	418	401	386
T_3	225	209	210	15.8	14.4	13.6	420	404	389
T_4	216	202	198	16.4	15.2	14.5	409	488	379
T_5	209	200	196	16.2	15.0	14.2	406	385	376
T_6	218	204	200	17.1	15.6	15.1	412	394	383
T_7	231	214	206	18.4	16.8	15.9	430	414	404
T_8	228	211	204	18.0	19.4	15.6	426	410	398
T_9	239	219	212	19.2	17.4	16.2	433	419	408
T_{10}	228	210	196	16.1	15.5	13.9	419	405	392
T_{11}	224	208	194	15.8	15.3	13.8	415	402	388
T_{12}	230	212	200	16.3	15.6	14.1	424	409	394
S.E.±	3.139	13.795	2.238	1.674	3.684	8.347	36.45	37.76	25.47
C.D. (P=0.05)	6.512	28.609	4.641	3.472	7.640	17.311	75.59	79.31	52.83

T_1 - Absolute control, T_2 - 100% NPK, T_3 - FYM @ 12.5 ha^{-1} + 100% NPK, T_4 - Compost mix (1), T_5 -Compost mix (2), T_6 - Compost mix (3), T_7 -Compost mix (1) + 100% NPK, T_8 -Compost mix (2) + 100% NPK, T_9 -Compost mix (3) + 100% NPK, T_{10} -Compost mix (1) + 75% NPK, T_{11} -Compost mix (2) + 75% NPK, T_{12} - Compost mix (3) + 75% NPK

(4835 kg ha^{-1}) followed by T_7 (4785 kg ha^{-1}).

Addition of rock phosphate added compost not only increased the soil available phosphorus but also the yield of sunflower. Also it had significant influence on sunflower plant height, dry matter production, grain yield and stalk yield. Application of poultry manure compost along with half and full doses of recommended levels of fertilizers recorded significant increase in oil per cent, oil yield, protein content and kernel yield over control. From the above findings, the coir pith + poultry waste compost @ 6 t ha^{-1} with 75 per cent levels of recommended N, P and K would be the better choice for cultivating sunflower. When poultry farms are relatively small with an integrated cropping system, the manure utilization is not a problem. Research has confirmed its value as good manure and also pointed to use as a soil fertility enhancer. Similar work related to the

Table 3 : Effect of poultry composts and different levels of fertilizer on plant height and dry matter production of sunflower

Treatments	Plant height (cm)			Dry matter production (kg ha^{-1})		
	Vegetative stage	Flowering stage	Harvest stage	Vegetative stage	Flowering stage	Harvest stage
T_1	29	102	152	354	1942	3620
T_2	35	132	166	442	3262	5120
T_3	42	146	177	549	3892	6002
T_4	33	120	150	392	2981	4612
T_5	35	126	159	402	3016	4762
T_6	36	128	157	409	3042	4812
T_7	44	149	192	612	4162	7812
T_8	46	159	181	612	5642	6432
T_9	45	163	194	646	5712	7916
T_{10}	39	140	169	532	3522	5120
T_{11}	42	142	178	632	4812	6020
T_{12}	43	145	183	639	4846	6126
S.E.±	3.944	14.89	19.28	50.70	492.16	675.75
C.D. (P=0.05)	8.179	NS	NS	105.34	1020.75	1409.80

T_1 - Absolute control, T_2 - 100% NPK, T_3 - FYM @ 12.5 ha^{-1} + 100% NPK, T_4 - Compost mix (1), T_5 -Compost mix (2), T_6 - Compost mix (3), T_7 -Compost mix (1) + 100% NPK, T_8 -Compost mix (2) + 100% NPK, T_9 -Compost mix (3) + 100% NPK, T_{10} -Compost mix (1) + 75% NPK, T_{11} -Compost mix (2) + 75% NPK, T_{12} - Compost mix (3) + 75% NPK NS=Non-significant

Table 4 : Effect of poultry composts and different levels of fertilizer on grain and stalk yield of sunflower

Treatments	Grain yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
T_1 - Absolute control	890	2420
T_2 - 100% NPK	1210	4137
T_3 - FYM @ 12.5 ha^{-1} + 100% NPK	1712	4412
T_4 - Compost mix (Poultry droppings + coir pith)	1110	3738
T_5 - Compost mix (Poultry droppings + paddy straw)	1196	3962
T_6 - Compost mix (Poultry droppings + coir pith + Rock phosphate)	1201	3912
T_7 -Compost mix (Poultry droppings + coir pith) + 100% NPK	1912	4785
T_8 -Compost mix (Poultry droppings + paddy straw) + 100% NPK	1862	4511
T_9 -Compost mix (Poultry droppings + coir pith + Rock phosphate) + 100% NPK	1915	4835
T_{10} -Compost mix (Poultry droppings + coir pith) + 75% NPK	1706	4211
T_{11} -Compost mix (Poultry droppings + paddy straw) + 75% NPK	1791	3538
T_{12} - Compost mix (Poultry droppings + coir pith + Rock phosphate) + 75% NPK	1772	4560
S.E.±	157.25	406.25
C.D. (P=0.05)	326.14	843.82

present investigation was also carried out by Petcu *et al.* (2001); Nanjundappa *et al.* (2001); Munir *et al.* (2007) and Saeed *et al.* (2002).

Conclusion :

Composting poultry waste with coir pith can be an effective method of conserving nitrogen in the poultry waste, which not only improves the manurial value, but also reduces environmental pollution.

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