INFLUENCE OF FRESH, COMPOSTED AND VERMICOMPOSTED *PARTHENIUM* AND POULTRY MANURE ON THE GROWTH CHARACTERS OF SESAME (*SESAMUM INDICUM*)

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Abstract

A goal of sustainable agriculture is to maintain a non-negative trend in productivity while maintaining soil quality. The objective of the present study was to determine the sustainability of organic cropping systems and utilisation of the weed *Parthenium hysterophorus* and an organic product poultry manure. The influence of fresh, composted and vermicomposted *Parthenium* and poultry manure on the growth characters of sesame (*Sesamum indicum*) were observed. Manures were mixed with pot soil at the rate of 35.0g/pot of fresh manures, 26.25, 35.0 and 43.75g/pot composted and vermicomposted *Parthenium* and poultry manure individually. The recommended dose of NPK/hectare was calculated and added to pots. The impact of fresh, composted and vermicomposted *Parthenium* and poultry manure were assessed on 30, 60 and 90 days after sowing (DAS) in terms of growth attributes and compared with control soil without manures and NPK. The germination percent of sesame was more in composted and vermicomposted manures applied pots compared to the control and NPK. The longest roots of sesame were in composted poultry manure (T11 and T9) on 30 and 60 DAS and in composted *Parthenium* (T3) on 90 DAS. Shoot length was more in T12 (vermicomposted poultry manure) on 30 DAS, T9 composted poultry manure on 60 DAS, T5 (vermicomposted *Parthenium*) on 90 DAS. Maximum fresh and dry weights were in T7 (vermicomposted *Parthenium*) on 30 and 90 DAS and in T9 (composted poultry manure) on 60 DAS. Maximum vigour index was observed to be more in composted poultry manure T10 on 30 and 90 DAS and in T11 on 60 DAS. The growth attributes of sesame were improved by manure application compared to the control. The significant differences in biometric parameters might be due to different treatments. The difference in the release of nutrients from different manures might have influenced the plant biometric characters. The observed parameters were improved by the treatments which could be attributed to the positive effects of composts and vermicomposts on physical, chemical and biological properties of soil which in turn influence the crop. Organic matter resources need to be evaluated to meet plant nutrient requirements. Recycling of wastes can transform them to useful composts for plant growth and soil health. In the present study, the use of weed biomass and poultry manure in compost was beneficial for the growth of sesame.

Keywords: sesame, growth attributes, *Parthenium*, poultry manure, compost, vermicompost.

Introduction

In the face of global ecological concern on the use of chemicals in agricultural production, alternative sources of plant nutrients such as poultry manure and plant residues can be tested as a source of nutrients for crop plants. The term organic farming is not directly related to the type of inputs used, but refers to the concept of farm as an organism, in which all the component parts - the soil minerals, organic matter, micro organisms, insects, plants, animals and humans interact to create a coherent role. Organic farming represents the restructuring of a whole farm system, rather than the adoption of current practices to reduce environmental impact (Chaudhary 2002).

Parthenium (*Parthenium hysterophorus*) continues to spread in undisturbed public, waste, abandoned, fallow lands in residential and industrial premises and lawns (Sharma and Gautam 2004). *Parthenium* and its harmful effects can be effectively reduced by converting it as compost. The species was ranked as the most important weed by 90% of the farmers in the lowlands. According to a partial canonical correspondence analysis (pCCA), altitude, rainfall, month of planting, number of weedings and soil type were the major environmental/crop management factors influencing the species distribution. *Parthenium* has, in a very short time period, emerged as one of the most troublesome weed species in eastern Ethiopia (Tamado and Milberg 2008). The high concentration of elements (N, P, K, Fe, Mn, Cu and Zn) in composted *Parthenium* may increase crop yields (Kishor *et al*. 2010). *Parthenium* compost contains two times more nitrogen, phosphorus and potassium than farm yard manure (Angiras 2008).

To sustain the fertility status of soil for efficient crop production, poultry waste can be used as a source of fertilizer particularly for nitrogen and phosphorus (Khan and Ali 2000). Poultry wastes contain higher concentrations of N, Ca and P than wastes from other farm animals (Stephenson *et al*. 1990). Composting may provide a beneficial alternative method for handling poultry litter due to the immobilization of nutrients and a reduction in litter volume (Millner *et al*. 1998). The slow release of nutrients from composted poultry litter may lessen adverse environmental effects from leaching of N in run-off from farm lands (Chang and Janzen 1996). Poultry manure increased soil organic matter, N and P. Soil bulk density were reduced and moisture content increased with levels of manure. Manure applications increased leaf N, P, K, Ca and Mg concentrations of tomato, plant height, number of branches, root length, number and weight of fruits. The 25 t ha^{-1} poultry manure gave highest leaf P, K, Ca and Mg and yield relative to control. The 10, 25, 40 and 50 t ha^{-1} manure levels increased average fruit weight by 58, 102, 37 and 31% respectively (Ewulo *et al.* 2008). Spain is one of the major producers of broilers and laying hens in the European Union, with an overall market share of around 12%. The poultry manure that is produced is usually employed as fertilizer on cropland, either directly or after a composting process (Quiroga *et al*. 2010).

Vermicompost, a potential organic input for sustainable agriculture, it contains beneficial microorganisms, both major (N, P, K) and micronutrients, enzymes and hormones (Probodhini 1994). The results of Avnish Chauhan and Joshi (2010) showed a high increase in nitrogen, potassium, phosphorus and a substantial decrease in organic carbon, C/N, C/P ratio in the experiment set up using earthworms. Adding of vermicompost to soil improves the chemical and biological properties of soil and thereby improves its fertility (Purakeyastha and Bhatnagar 1997). Earthworms constitute more than 80% of soil invertebrate populations in many ecosystems, especially in the tropical ecosystems (Sinha *et al.* 2002)*.* Micro-organisms in composting require C, N, phosphorus (P) and potassium (K) as the primary nutrients. Of particular importance is the C:N ratio of raw materials. The optimal C:N ratio of raw materials is between 25:1 and 30:1 although ratios between 20:1 and 40:1 are also acceptable. Where the ratio is higher than 40:1, the growth of micro-organisms is limited, resulting in a longer composting time. A C:N ratio of less than 20:1 leads to underutilization of N and the excess may be lost to the atmosphere as ammonia or nitrous oxide, and odour can be a problem. The C:N ratio of the final product should be between about 10:1 and 15:1 (Misra *et al*. 2003).

The objective of this investigation was to evaluate the efficacy of fresh, composted and vermicomposted *Parthenium* and poultry manure on the growth parameters of sesame (*Sesamum indicum*).

Materials and methods

An experiment was conducted to determine the effect of fresh, composted and vermicomposted *Parthenium* and poultry manure on the growth attributes of sesame. The treatments are listed in Table 1. The experiment was completely randomized design with three replications. The dosages were designed for the present study as per the recommendations of Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India for red soil and also based on the nutrient contents of the manures. The NPK levels applied were the recommended dosage for the sesame plant variety used in this experiment.

Table 1. List of fresh and composted *Parthenium*, poultry manure and vermicompost treatments and their application rates.

Number	Treatment	Rate (g/pot)
T0	Control, 7 kg red loamy soil	
T1	Fresh *Parthenium*	35.0
T2	Composted *Parthenium*	26.25
T3	Composted *Parthenium*	35.0
T4	Composted *Parthenium*	43.75
T5	Vermicomposted *Parthenium*	26.25
T6	Vermicomposted *Parthenium*	35.0
T7	Vermicomposted *Parthenium*	43.75
T8	Fresh poultry manure	35.0
T9	Composted poultry manure	26.25
T10	Composted poultry manure	35.0
T11	Composted poultry manure	43.75
T12	Vermicomposted poultry manure	26.25
T13	Vermicomposted poultry manure	35.0
T14	Vermicomposted poultry manure	43.75
T15	NPK mineral fertiliser	35:2:23 kg/ha

Nutrient contents of the organic inputs

The fresh, composted and vermicomposted *Parthenium* and poultry manure were assessed for its nutritional value in terms of micro- and macro-nutrients, physico chemical parameters and microbial population. The decomposition exhibited significant variation from the fresh forms and the improved nutrient value was assessed in this experiment.

The content of organic carbon (C) varied among the fresh and decomposed samples. It was 2.02% in fresh *Parthenium* and reduced to 0.87% in composted *Parthenium* and 1.03% in vermicomposted *Parthenium*. The organic matter was found to be 3.49%, 1.50% and 1.78% for fresh, composted and vermicomposted *Parthenium*. The fresh *Parthenium* recorded the lowest per cent of total Nitrogen (N) (0.62%), the composted *Parthenium* (2.10%) and vermicomposted *Parthenium* (2.30%) exhibited higher values. While the fresh sample recorded the least value of 0.10% for Phosphorus (P), it was found to be 0.30% in composted *Parthenium* and 0.42% in vermicomposted *Parthenium*. The Potassium (K) content was recorded to be 0.32% in fresh and 1.20% and 1.36% in composted and vermicomposted *Parthenium* samples. Zinc (Zn) and Copper (Cu) contents were lower in fresh *Parthenium* (178 and 76 ppm) compared to the composted (210 and 82 ppm) and vermicomposted *Parthenium* (235 and 80 ppm). The Iron (Fe) content was lower (76 ppm) in composted *Parthenium* compared to both fresh (84 ppm) and vermicomposted samples (94 ppm). Manganese (Mn) content was observed to be 125 ppm, 140 ppm and 156 ppm respectively in fresh, composted and vermicomposted *Parthenium*. The C:N ratio of the decomposed samples showed a steady reduction from 3.26 (fresh *Parthenium*) to 0.41 in composted and 0.45 in vermicomposted *Parthenium* . There was a drastic reduction in C:P ratio of the samples from 20.20 in fresh sample to 2.90 and 2.45 in composted and vermicomposted samples.

It was observed that there was a gradual reduction in organic C content from fresh poultry droppings (2.00%) to composted (0.61%) and vermicomposted (0.93%) samples. The organic matter was also less in composted poultry droppings (1.05%) compared to fresh poultry droppings (3.44%) and vermicomposted poultry droppings (1.59%). The vermicomposted sample registered the least content of N (1.20%) and the highest value was recorded in fresh form (2.87%) and composted poultry droppings had a content of 2.07%. The P contents of fresh, composted and vermicomposted samples were 2.90, 2.38 and 1.11%, respectively. The fresh poultry droppings had a higher content of K (2.35%) which was reduced to 1.50% in composted and 0.80% in vermicomposted samples. The highest contents of Zn and Cu (85 and 46 ppm) were found in fresh form which were reduced to 36 and 4.4 ppm in vermicomposted poultry droppings and 50 and 6.9 ppm in composted sample. The Fe and Mn contents were 107 and 190 ppm in compost, 101 and 187 ppm in vermicompost samples and least in fresh poultry droppings (38 and 44 ppm). The C:N ratio of fresh and vermicomposted samples were 0.70 and 0.78. The composted sample recorded a C:N ratio of 0.29 .The C:P ratio of fresh poultry droppings was 0.69 and 0.41 in compost. The vermicomposted sample showed a C:P ratio of 0.84

Growth attributes

One plant per replication was selected from each treatment and washed to remove adhering soil particles. Root length was measured from root collar to root tip and shoot length was recorded from root collar to shoot apex. The fresh weight of the whole plant was measured then the plant was placed in an oven at 70°C for 12 hours and the dry weight recorded. The vigour index was calculated using the formula, vigour index = germination percentage x (root length + shoot length) (Abdul-Baki and Anderson 1973).

Statistical analysis

The data collected from the different treatments were subjected to statistical analysis using one way analysis of variance and group means were compared using Duncan's Multiple Range Test. *P* values at 5% were considered significant (Panse and Sukhatme 1978). The Standard Error and Critical Difference among the treatments were reported.

Results

Germination percentage

The germination percentage of sesame was calculated on 7, 14, 21 and 28 days after sowing (DAS) and depicted in Table 2. On 7 DAS, the highest germination percentage of 60% was observed in T1 and T15 and least in T14 (17%). On 14 DAS 80% germination was observed in T3 and T7 among *Parthenium* applied plants and in T10 (83%) amongst poultry manure applied plants. The lowest value of 53% was observed in

T9 and T14. On 21 and 28 DAS, T3, T7, T10 and T11 recorded the highest value of 83% and the lowest value of 57% in T14. The growth attributes of sesame namely root length, shoot length, fresh weight, dry weight and vigour index were observed on 30, 60 and 90 DAS (Table 2).

Root length

On 30 DAS, the longest root was observed in T6 as 7.40 cm among *Parthenium* and in T11 as 10 cm among poultry manure treatments. The shortest root was recorded in T13 (4.3 cm). On 60 DAS, T7 among *Parthenium* (11.5 cm) and T9 among poultry manure treatments (14.8 cm) registered the longest root against control (6.1 cm), which showed the minimum root length. On 90 DAS, maximum root lengths of 22.4 and 18.2 cm were observed in T3 and T8 among *Parthenium* and poultry manure applied plants; the minimum value was seen in T14 (7.1 cm) (Table 2).

Shoot length

The shoot length was positively affected by T7 (15.8 cm) among *Parthenium* and T12 (17.6 cm) among poultry manure treatments at 30 DAS. The T8 plants exhibited the shortest shoot length at 8.0 cm on 30 DAS. The greatest shoot length was seen in T7 (58.2 cm) among *Parthenium* and T9 (70.2 cm) among poultry manure treatments on 60 DAS with the shortest in the control (25.0 cm). On 90 DAS, the shoot length was highest in T5 (87.5 cm) and in T10 (85.1 cm) among *Parthenium* and poultry manure applications and the control (42.0 cm) showed the lowest length of shoot (Table 2).

Table 2. Impact of fresh, composted and vermicomposted *Parthenium* and poultry manure on growth of sesame (SE = Standard Error; CD = Critical Difference; DAS = Days After Sowing).

Treatments	Germination (%)				Root length (cm)			Shoot length (cm)		
	7 DAS	14 DAS	21 DAS	28 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T0	40.00	66.67	66.67	66.67	4.73	6.13	9.73	8.60	25.00	42.03
T1	60.00	76.67	76.67	76.67	4.87	7.43	12.67	11.40	50.90	77.50
T2	23.33	63.33	66.67	66.67	4.97	6.43	15.90	8.13	33.07	87.30
T3	40.00	80.00	83.33	83.33	6.90	7.27	22.37	11.87	34.13	66.93
T4	30.00	76.67	80.00	80.00	6.23	6.50	9.23	10.97	27.40	81.17
T5	56.67	73.33	76.67	76.67	6.90	7.70	7.27	13.50	43.80	87.53
T6	46.67	76.67	80.00	80.00	7.40	9.30	7.23	14.33	53.00	55.57
T7	53.33	80.00	83.33	83.33	7.20	11.53	13.53	15.77	58.17	77.70
T8	30.00	63.33	76.67	76.67	9.57	9.43	18.17	8.03	47.40	84.70
T9	40.00	53.33	60.00	60.00	4.90	14.83	14.07	13.50	70.23	83.80
T10	33.33	83.33	83.33	83.33	7.53	9.73	17.83	17.07	57.57	85.10
T11	43.33	70.00	83.33	83.33	10.20	10.13	14.50	11.20	65.13	84.60
T12	30.00	63.33	70.00	70.00	6.17	7.70	8.33	17.60	48.53	58.60
T13	20.00	60.00	63.33	63.33	4.30	7.20	7.90	16.13	52.70	59.67
T14	16.66	53.33	56.67	56.67	4.80	7.27	7.13	16.83	43.80	43.43
T15	60.00	63.33	70.00	70.00	5.00	6.97	9.30	11.83	42.20	64.03
SE	11.22	8.69	6.38	6.38	0.45	0.42	1.34	0.53	1.30	1.06
CD (5%)	22.91**	17.74*	13.02**	13.02**	0.93**	0.85**	2.73**	1.08**	2.65**	2.17**

Fresh weight and dry weight

The fresh weight of the plants in T7 and T10 exhibited the greatest values of 1.5 and 1.2 g on 30 DAS among *Parthenium* and poultry manure compared to the control (0.3 g). On 60 DAS, the greatest fresh weight was recorded in T6 (7.7 g) within the *Parthenium* treatments and T9 (18.6 g) within the poultry manure treatments against control (2.0 g). The greatest fresh weights, 27.9 and 15.7 g, were noticed in T7 and T10 among *Parthenium* and poultry manure applications on 90 DAS and the lowest fresh weight was 4.7 g in the control (Table 3).

On 30 DAS, the dry weight was found to be greatest in T7 (0.76 g) and T10 (0.60 g) among *Parthenium* and poultry manure applications and the lowest in the control (0.13 g). On 60 DAS, the highest dry weight was noticed in T6 (1.8 g) within the *Parthenium* treatments and in T9 (4.7 g) within the poultry manure applications compared to T0 (0.47 g) which was the lowest. The dry weight was found to be greatest in T7 (6.4 g) within the *Parthenium* treatments and T10 (5.4 g) within the poultry manure treatments on 90 DAS and lowest in the control T0 (1.1 g) (Table 3).

Vigour index

The maximum vigour index of sesame plants was observed in T7 (1915) within the *Parthenium* treatments and T10 (2044) within the poultry manure treatments and minimum in T0 (904) on 30 DAS. On 60 DAS the value of vigour index was greatest in T7 (5807) within the *Parthenium* treatments and T11 (6282) within the poultry manure treatments and lowest in the control (2522). The maximum value of vigour index was 7911 (T2) within the *Parthenium* treatments and 8585 (T10) within the poultry manure treatments on 90 DAS against a minimum value of 3459 in T0 (Table 3).

Table 3. Impact of fresh, composted and vermicomposted *Parthenium* and poultry manure on yield of sesame (SE =Standard Error; CD = Critical Difference; DAS = Days After Sowing).

Treatments	Fresh weight (g)			Dry weight (g)			Vigour index		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T0	0.27	2.00	4.71	0.13	0.47	1.08	904.33	2522.00	3459.33
T1	0.85	5.32	9.82	0.35	1.14	3.53	1200.67	4478.00	6914.67
T2	0.39	2.71	9.76	0.19	0.47	3.78	856.00	2635.00	7911.00
T3	0.72	3.98	9.53	0.27	0.73	3.66	1562.33	3448.67	7438.67
T4	0.99	3.30	14.64	0.46	0.69	4.36	1380.33	2719.33	7501.00
T5	0.74	5.61	14.85	0.26	0.94	4.76	1566.33	3948.33	7268.67
T6	0.84	7.68	9.57	0.37	1.80	3.49	1731.33	4977.67	5023.67
T7	1.53	6.43	27.85	0.76	1.46	6.37	1914.67	5807.00	7602.67
T8	0.34	10.07	12.97	0.16	2.24	4.23	1329.67	4361.00	7898.00
T9	0.60	18.56	11.59	0.28	4.69	3.85	1104.67	5114.33	5868.33
T10	1.21	8.02	15.70	0.60	1.87	5.40	2044.00	5608.67	8584.67
T11	0.55	11.44	10.52	0.28	3.65	3.36	1782.00	6282.00	8258.33
T12	1.02	3.93	5.59	0.54	0.82	1.28	1661.67	3932.33	4679.67
T13	0.70	4.28	5.70	0.34	0.79	1.52	1294.00	3798.00	4286.67
T14	0.64	4.52	6.37	0.31	0.77	1.44	1223.67	2882.67	2528.33
T15	0.35	2.55	8.30	0.16	0.67	1.83	1143.33	3441.67	5133.33
SE	0.07	0.24	0.60	0.03	0.11	0.25	125.20	419.83	594.74
CD (5%)	1.14**	0.49**	1.22**	0.06**	0.23**	0.50**	255.69**	857.43**	1214.64**

Discussion and conclusion

The sesame root length was more in composted poultry droppings and *Parthenium* treatments compared to the vermicomposted and fresh forms and NPK. Application of organic manures might have supplied N, P and K nutrients through out the crop growth period as slow released nutrients. The length of shoots was increased in composted and vermicomposted poultry droppings and vermicomposted *Parthenium* treatments than in fresh *Parthenium*, poultry droppings and NPK. Nethra *et al*. (1999) observed that the maximum plant height and number of leaves of China aster (*Callistephus chinensis*) were after application of 10 t/ha vermicompost. This is attributed to better growth of plants and higher yield by slow release of nutrients for absorption with additional nutrients like gibberellin, cytokinin and auxins, by the application of organic inputs like vermicompost. The fresh and dry weights of sesame was higher in vermicomposted *Parthenium* and in composted poultry droppings applications. The plants showed higher vigour index in composted poultry droppings applied plants than other treatments. Composted poultry manure increased plant height, dry matter, production, leaf area index and number of branches per plant in cowpea (Rajavel 2002). This might be due to better N release from organic manures and better crop growth was the result of adequate nutrition. Vermicomposted market waste resulted in significant increase in morphological parameters of *Vigna mungo* (Balamurugan and Vijayalakshmi 2004). The presence of vermicompost enhances the macro and micro nutrients uptake by plants, and it harbours rich amounts of microbes that degrade and mobilize the nutrients to available form. Exudates of earthworms support the micro organisms which secrete plant growth hormones. Benefits have been attributed to the additional availability of N, P and K nutrients in the soil due to the application of organic manures and also conversion of unavailable form of nutrients into available forms. Singh *et al*. (1997) found that an application of 7.5 – 10 t ha^{-1} vermicompost to wheat (*Triticum aestivum*) was able to save about 50 kg N, 60 kg P_2O_5 and 25 kg $ZnSo_4$ per ha and this may well facilitate a step towards complete organic farming. The yield of potato and the average weight of potato tubers were significantly higher in plots treated with vermicompost. This may be attributed to increased bioavailability of P by the application of organic amendment in the form of vermicompost (Ansari 2008).

From the results of the present investigation, it could be concluded that composted *Parthenium* and poultry manure can be used for preparing organic manures and be used in successfully increasing crop productivity as an alternative source to inorganic fertilizers. The introduction of organics is beneficial in the successful production of sesame. This research showed that significant relationships exist between the utilisation of the various manures and plant growth. Further studies may be designed investigating other crops and soil types.

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