



Effect of recycling of seri-vermicompost on growth, yield and nutrients of maize (*Zea mays*)

R SHANMUGAM¹ and K RAMAMOORTHY²

Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641 003

Received: 6 December 2012; Revised accepted: 30 April 2014

ABSTRACT

Field experiments were conducted at Thalingipalayam block (Avinashi, block), Tamil Nadu (India) during *kharif* and *rabi* seasons of 2011-2012 to study the effect of recycling of seriwaste compost (organic manure) with other organics and inorganics on the productivity of maize crop. The experiments were laid out in randomized block design with three replications. Two source of organic manures, viz. seriwaste compost + animal and poultry wastes were imposed along with Nitrogen (N), Phosphorus (P), Potassium (K) levels (150:75:75 kg/ha), viz. 100% of Recommended Dose of Fertilizer (RDF) (T₁), 75% of RDF + 25% organic manure (T₂), 50% of RDF + 50% organic manure (T₃), 25% of RDF + 75% organic manure (T₄), 100% of RDF+75% of organic manure (T₅), 100% organic manure alone (T₆) and absolute control (T₇). Organic manures applied to crop of maize with different levels of NPK to all plots. The results revealed that 100% RDF + 75% organic manure were increased the growth and, yield attributes, yield and nutrients, which was followed by 50% RDF +50% organic manure with enhanced B/C ratio.

Key words: B:C ratio, Maize, Nutrient uptake, Productivity, Quality, Seriwaste

Sericulture is a commercially sustainable farm based economic enterprise favouring rural poor in the unorganized sector, because of its relatively low requirement of fixed capital and high return.

In recent years, recycling of crop residues has received considerable interest. In sericulture farms, the left over mulberry leaves from rearing bed and field and other waste including silkworm litter are not properly utilized in preparing compost of highly organic and nutritive value. Hence, it is essential to convert the sericulture farm waste in to valuable compost by adopting suitable technology. Sericulture waste serves as a good source of organic nutrients for the crops. Seriwaste contains more amounts of plant nutrients like macro and micro nutrients which contribute to increased production as compared to any other organic manure.

Recently, using the seriwaste to the field crops to increase their yield and quality of the food grains is a new trend. The success of future agriculture depends upon sustainability of production system. This has necessitated research on use of organic manures. It helps farmers to reduce input cost of commercial fertilizers, thereby increasing the profit margin. Nutrients contained in organic manures are released more slowly and stored for a long time in the soil, ensuring a long residual effect (Sharma and Mittra 2007) and sustaining soil fertility.

¹ Ph D Scholar (e mail: sunmuga152@gmail.com); ² Professor (Agronomy), (e mail: thirukariram@yahoo.com), Department of Sericulture

Maize (*Zea mays* L.) is one of the most important cereal crop grown all over the globe as poor man's food and also as cattle and poultry feed. It is also a versatile crop, allowing it to grow across a wide range of agro ecological zones. Thus, it has been realized that application of chemical fertilizers in conjunction with organic manures will sustain and maintain the productivity of soil. Therefore, it is necessary to compare various organics as well as chemical fertilizers in order to find out the most effective integrated nutrient combination in maize crop.

MATERIALS AND METHODS

Seriwaste compost (organic manures) was prepared in the farmer's field in Avinashi, Tiruppur (District), Tamil Nadu (India) as per the following standard recommended procedure. Rearing waste and mulberry farm residues and weeds (removed before flowering) are collected in a pit of convenient size with 1 m depth. The left over stems/shoots can also be decomposed. However, they should be crushed before putting them in pit, which makes their decomposition faster. The thin layer of cattle dung and poultry waste and water or spent slurry of biogas plant are spread into the pit regularly after every collection of one foot thick compacted layer of the wastes. When the pit is filled, it is plastered with a layer of mud and cattle dung. The pit should be protected from rain and direct sunlight by providing a thatched shed over it. As decomposition process usually takes about 4-5 months, the pit should be left undisturbed and opened only after 5 months. Seriwaste containing of

nutrients presented below as reported by several scientists.

Organic sources of nutrients	Nutrient content (%)						
	N	P	K	P	Ca	Mg	Su
Farmyard manure	0.50	0.40	0.60	19.46	1.69	0.72	0.30
Seriwaste	2.90	0.94	1.70	19.06	1.66	0.71	0.29

Seeds of maize hybrid CoH(M)5 was obtained from Department of Millets, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, were used for the study. The plant spacing adopted is 60 × 30 cm as per the recommendation. The inorganic fertilizers, viz. N, P and K in the form of urea, single super phosphate and muriate of potash dose of 150:75:75 kg/ha were applied as per the treatment schedule.

The experiment was laid out in randomized block design with three replications. Treatment details: T₁ – 100% Recommended dose (RDF) of NPK, T₂ – 75% RDF + 25% *organic manure, T₃ – 50% RDF + 50% *organic manure, T₄ – 25% RDF + 75% *organic manure, T₅ – 100% RDF + 75% *organic manure, T₆ – 100% *organic manure alone and T₇ – absolute control. *(Silkworm rearing waste + animal waste + poultry waste + crop waste)

Five plants from each net plot area were chosen by random and tagged. All the biometric observations were recorded from those tagged plants at 30, 60 and 90 day after sowing (DAS) and the mean of observations were taken. These plants were used for recording all biometric observations at different stages of crop growth and yield. The data were subjected to Fisher's method of analysis of various and level of significance used in F-test was P= 0.05. The critical differences were calculated at 5 percent probability level whenever F value was found to be significant.

RESULTS AND DISCUSSION

Growth parameters

Plant height (cm): The plant height measured by different growth stages were influenced by the application

of organic manures and inorganic fertilizer levels at 90 days after sowing (DAS). Among the treatment combinations, application of 100% RDF + 75% organic manure (T₅) recorded taller plants (320 cm) followed by 50% RDF + 50% organic manure (T₃) which was on par with 75% RDF + 25% of organic manure (T₂). The plant height was lowest with absolute control (T₇) (215 cm) (Table 1). This might be due to better nutrient release from the organic manures and better crop growth might be the result of adequate nutrition (Chandrasekara *et al.* 2000). *Leaf Area Index (LAI)*: The highest LAI was noticed on combined application of the organics and inorganics like 100% RDF + organic manure 75% (T₅) (4.68) followed by (T₃) and (T₁) as compared to other treatment combinations (Table 1). Improved growth parameters of maize due to organic manure with inorganic fertilizer application in maize as earlier reported by Nanjappa *et al.* (2000). *Number of leaves*: Among the treatment combinations, application of 100% RDF + 75% organic manure (T₅) recorded more number of leaves irrespective of the stages of observations (12.20) followed by the 75% RDF + 25% organic manure (T₂). The number of leaves was lowest with the absolute control (T₇) (9.60).

Crop Growth Rate (CGR) + Relative Growth Rate (RGR): Among the treatments application of 100% RDF + 75% organic manure (T₅) (22.13) and (0.033) recorded higher value followed by 50% of RDF + 50% organic manure (T₂). Whereas, in absolute control (T₇) recorded very lowest value (18.84) and (0.015) than the other treatments in all the stages (Table 1). The steady and continuous supply of N through organics like seriwaste compost might have promoted the growth and yield characters. Similar results were also reported by Balasubramanian and Palaniappan (1995).

Plant dry matter production (kg/ha): Among the combinations of treatments, application of 100% RDF + 75% organic manure (T₅) recorded highest dry matter production (16188 kg/ha) followed by application of 50% RDF + 50% organic manure (T₃) at 90 DAS. Also among the treatments 75% RDF + 25% organic manure (T₂) was comparable and registered more dry matter production with

Table 1 Effect of seri-vermicompost (organic manure) and inorganic fertilizers on growth parameters of *Zea mays* (Pooled data)

Treatment	Plant height (cm)	Leaf Area Index	No. of leaves / plant	Crop growth rate (60-90 DAS)	Relative growth rate (60-90 DAS)	DMP (kg/ha)
T1 – 100% Recommended dose (RDF) of NPK	249	3.25	11.03	20.76	0.021	14 329
T2 – 75% RDF + 25% *organic manure	264	3.65	11.40	21.43	0.025	15 502
T3 – 50% RDF + 50% *organic manure	282	3.76	11.20	21.50	0.027	15 652
T4 – 25% RDF + 75% *organic manure	243	3.01	10.80	19.80	0.020	12 525
T5 – 100% RDF + 75% *organic manure	320	4.68	12.20	22.13	0.033	16 188
T6 – 100% *organic manure alone	238	2.56	10.40	19.91	0.019	12 474
T7 – Absolute control	215	2.09	9.60	18.84	0.015	11 774
SEd	11.20	0.207	0.078	0.189	0.002	83.240
CD _(0.05)	24.40	0.452	0.171	0.412	0.005	181.38

*(Silkworm rearing waste + Animals waste + Poultry waste + Crop waste)

(T₃) (Table 1). Seriwaste compost at 25, 50 and 75 per cent along with 75, 50 and 25 per cent RDF produced comparably higher growth parameters like taller plants, higher LAI and more DMP application at all growth stages as compared to other treatment combinations. This might be due to better nutrient release from the organic manures and better crop growth might be the result of adequate nutrition (Chandrasekara *et al.* 2000).

Yield attributes

Number of rows per cob: Number of rows per cob was significantly varied by the application of organic manures and inorganic fertilizer levels. Application of 100% RDF + 75% organic manure (T₅) (16.76) which was followed by 50% RDF + 50% organic manure (T₃) recorded more number of rows per cob (16.22) and on par with 75% RDF + 25% organic manure (15.91). Whereas, the rows per cob was lowest (9.88) with the absolute control (T₇) (Table 2). The combined application of organic and inorganic fertilizer led to a significant increase in yield of maize and it has been indicated earlier by Kalaiyarasan (2011).

Length of cob (cm): Length of cob was significantly varied by the application of organic manures and inorganic fertilizer levels. Application of 100% RDF + 75% of organic manure (T₅) recorded higher values (20.64 cm) of cob length which was followed by 50% RDF + 50% organic manure (T₃) and 75% RDF + 25% organic manure (T₂) (Table 2). The positive influence of the higher doses of applied NPK could be attributed to their favourable effect on yield attributes of plants. The results are in conformity with that report of Pattanashetti *et al.* (2002) as reported that maize being a quick and heavy feeder it responded conspicuously to application of chemical fertilizers as earlier observed by Gill *et al.* (1994) and Sahoo and Panda (2000). **Girth of cob (cm):** Application of 100% RDF + 75% organic manure (T₅) was noticed longest girth of cob followed by 50% RDF + 50% organic manure (T₃) and 75% RDF + 25% organic manure (T₂) which recorded the higher values (7.87 and 7.75 cm) of cob girth. Similar results were also reported in maize-wheat cropping system by Gill *et al.* (1994).

Cob weight (g): Cob weight was significantly differed by the application of organic manures and inorganic fertilizer levels. Application of 100% RDF + 75% organic manure (T₅) recorded the highest cob weight (222.60 g) followed by (T₃), (T₂), (T₁), (T₄) and (T₆) respectively. The cob weights were lowest (133.40 g) with the absolute control (T₇).

Test weight (g) (100 grain weight): Hundred grain weight showed significant variation due to the application of organic manures and inorganic fertilizer levels. Application of 50% RDF + 50% organic manure (T₃) recorded the highest (31.43 g) test weight next by (T₅) 100% RDF + 75% of organic manure followed by other treatments (Table 2). In maize, increased growth parameters made the yield attributes, viz. length of cob, width of cob, number of rows/cob, number of grains/row, test weight

Table 2 Effect of treatments on yield attributes and yield of maize (Pooled data)

Treatment	No. of rows / cob	Cob length (cm)	Cob girth (cm)	Cob weight (g)	Test weight (g)	Grain yield	Stover yield
T1	12.72	18.61	5.97	184.83	22.93	5 652	10 044
T2	15.91	19.01	7.75	191.40	24.92	6 098	10 597
T3	16.22	19.23	7.87	204.90	25.39	6 243	10 831
T4	11.62	18.28	5.87	178.40	23.31	5 414	9 295
T5	16.76	20.64	8.77	222.60	31.43	6 828	11 647
T6	11.10	17.38	5.77	171.60	22.19	4 718	9 130
T7	9.88	13.24	4.77	133.40	20.24	3 651	6 914
SEd	0.210	0.156	0.060	5.070	0.654	77.31	114.24
CD _(P=0.05)	0.459	0.341	0.132	11.04	1.427	168.45	248.91

*(Silkworm rearing waste + Animals waste + Poultry waste + Crop waste)

were more and acceleration in the translocation of photosynthates might resulted in increased yield attributes. Findings of Gill *et al.* (1994) were in line with the findings of Sahoo and Panda (2000).

Yield

Grain yield (kg/ha): Grain yield was significantly influenced by the application of organic manures and inorganic fertilizer levels. Higher grain (6 828 kg/ha) yield was recorded with the application of 100% RDF + 75% of organic manure which was followed by 50% RDF + 50% organic manure (T₃) which was on par with the application (T₅) of 75% RDF + 25% organic manure (T₂). The grain yields were lowest (3 651 kg/ha) with the absolute control (T₇) (Table 2). The combined application of organic and inorganic fertilizer led to a significant increase in yield of sorghum and it has been indicated earlier by Gangwar and Niranjana (1991). **Stover yield (kg/ha):** Significant variation was observed in stover yield as influenced both by the application of organic manures and inorganic fertilizer levels. Higher stover (11 647 kg/ha) yield was recorded with the application of 100% RDF + 75% of organic manure (T₅). Application of 50% RDF + 50% organic manure (T₃) which was on par with 75% RDF + 25% organic manure (T₂). The stover yields were lowest (6 914 kg/ha) with the absolute control (T₇) (Table 2). The positive influence of the higher doses of applied NPK could be attributed to their favourable effect on yield attributes of plants. The results are in conformity with that report of Pattanashetti *et al.* (2002) as reported that maize being a quick and heavy feeder it responded conspicuously to application of chemical fertilizers as earlier observed by Gill *et al.* (1994) and Sahoo and Panda (2000).

Nutrient uptake by maize plant

Nitrogen (N) uptake was significantly influenced by organic and inorganic fertilizers at the time of harvest. Among the different treatments 100% RDF + 75% organic manure (T₅) recorded more N uptake (149 kg/ha) followed

Table 3 Effect of treatments and their nutrients use efficiency and post-harvest soil available nutrients (Pooled data)

Treatment	Maize uptake (kg/ha)			Nutrients use efficiency (%)			Soil available nutrients (kg/ha)		
	N	P	K	N	P	K	N	P	K
T1_114.4 • 25.7 • 112.4 • 14.9 • 17.8 • 4.65 • 195 • 31.6 • 318 • 25.7	112.4	14.9			17.8		4.65	195	31.6

Table 4 Effect of seri-vermicompost (organic manure) and inorganic fertilizers on economics of maize

Treatment	Gross return (₹/ha)	Cost of cultivation (₹/ha)	Net return (₹/ha)	B : C ratio
T1 – 100% Recommended dose (RDF) of NPK	36 834.92	12 674	24 160.92	1.91
T2 – 75% RDF + 25% *organic manure	38 599.49	11 309	27 290.49	2.41
T3 – 50% RDF + 50% *organic manure	40 713.09	11 683	29 030.09	2.48
T4 – 25% RDF + 75% *organic manure	29 341.85	11 357	17 984.85	1.58
T5 – 100% RDF + 75% *organic manure	44 467.66	11 758	32 709.66	2.78
T6 – 100% *organic manure alone	29 278.29	11 375	17 903.29	1.57
T7 – Absolute control	23 981.38	10 885	13 096.38	1.20

Price of maize grain ₹ 6/kg; Price of maize stover ₹ 0.30/kg

by 50% RDF + 50% organic manure (T₃) and 75% RDF + 25% organic manure (T₂) (141 kg/ha) as compared to other treatments (Table 3). Similar trend was also observed in P and K uptake of 30.5 and 59.70 kg/ha as in N uptake at the time of harvest, respectively. Application of organic manure at different levels recorded higher available N, P and K and least values were obtained under absolute control. Improved nutrients availability with graded levels of fertilizers was reported by Jayanthi *et al.* (1997) and Malewar *et al.* (1999). The favorable and beneficial effect of organic manures on available soil nutrient status which might be the reason for greater availability of nutrients to crop in the presence of organic manures and their solubilizing effect of different forms of nutrients present in soil (Ghosh *et al.* 2002).

Nutrients use efficiency

The highest nutrients use efficiency of 20.0, 27.5 and 6.89% of N, P and K was registered by treatment 5. Among the other treatments, the order of nutrients use efficiency was T₃>T₂>T₁>T₄ and T₆ (Table 3) (Fig 1). The favorable and beneficial effect of organic manures on available soil nutrient status which might be the reason for greater availability of nutrients to crop in the presence of organic

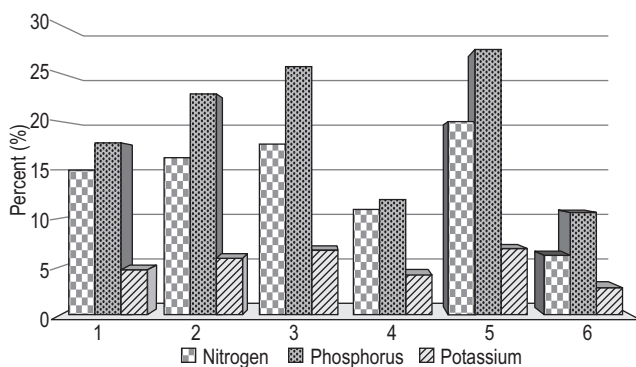


Fig 1 Effect of treatments on nutrients use efficiency

manures and their solubilizing effect of different forms of nutrients present in soil (Ghosh *et al.* 2002).

Post harvest soil available nutrients

Among the different treatments, 100% RDF + 75% organic manure registered more soil available N (236 kg/ha) followed by 50% RDF + 50% organic manure and 75% RDF + 25% organic manure with values of (220 and 217 kg/ha). The absolute control (T₇) recorded lowest soil available nitrogen (161 kg/ha) than that of other treatmental combinations (Table 3). This might be due to the increased soil enrichment as a result of increased N, P and K availability through organic manures. Similar results of increased nutrient status due to application of organics as reported early by Rajkhowa *et al.* (2000) and Subha and Gajendragiri (2004). This may be attributed to the direct addition and slow release of N, P and K through organic manures added to the soil (Jat and Ahlawat 2004). Similarly, nutrient balance studied earlier by Malewar *et al.* (1999) revealed that there was a considerable improvement in the NPK status of the soil with the application of organic manures coupled with inorganic fertilizer in sunflower and cotton. Soil available P was found to be higher in the 100% RDF + 75% organic manure (42.8 kg/ha) followed by 50% RDF + 50% organic manure and 75% RDF + 25% organic manure. Similar trend was also observed in soil available K status as in soil P status (Table 3). The absolute control recorded lowest soil available phosphorus (18.4 kg/ha). Increased uptake by maize was also due to higher fertility status of the soil. Similar findings were also reported by Gangwar and Niranjana (1991) and Misra *et al.* (1994).

Economics

The benefit cost ratio of was worked out for different treatments are presented in Table 4. Higher benefit cost ratio of 2.78 was obtained in the treatment 5. This was followed by T₃>T₂>T₁>T₄>T₇ and T₁.

Conclusion

Based on the result of the experiment on evaluation of seriwaste compost on the productivity of maize crop the following recommendation is made. Basal application of 50 per cent seriwaste compost (2.5 tonnes/ha) combined with 50 per cent of recommended NPK (75: 37.5: 37.5 kg/ha) as P and K basal along with 25 per cent N as basal, the remaining 50 per cent and 25 per cent of N at 25 DAS and 45 DAS as split application to maize crop and increased the productivity of maize with considerable improvement in soil fertility and enhanced the economic returns under irrigated conditions.

REFERENCES

- Balasubramanian P and Palaniappan S P. 1995. Effect of organic farming and inorganic fertilizer on plant growth, nutrient and yield of groundnut. (In) *Proceedings of National Symposium on Organic Farming*, 27-28 October, 1995. AC & RI, Madurai, pp 3-74.
- Chandrasekara C P, Harlapur S I, Muralikrishna S and Girijesh G K. 2000. Response of maize to organic manures with inorganic fertilizers. *Karnataka Journal of Agricultural Science* **13** (1): 144-6.
- Gangwar K S and Niranjana K P. 1991. Effect of organic manures and inorganic fertilizers on rainfed fodder sorghum (*Sorghum bicolor*). *Indian Journal of Agricultural Science*, **61** (3): 193.
- Ghosh P K, Manda, K G, Bandyopadhyay K K, Hati K M, Subbarao A and Tripathi A K. 2002. Role of plant nutrient management in oilseed production. *Fertilizer News* **47** (11): 67-77 & 79-80.
- Gill M S, Singh T, Rana D S and Bhandari A L. 1994. Response of maize (*Zea mays*) and wheat (*Triticum aestivum*) to different levels of fertilization. *Indian Journal of Agronomy* **39** (1): 168-70.
- Kalaiyarsan V. 2011. 'Utilization of seriwaste compost as a supplement to inorganic fertilizer in hybrid maize - cowpea cropping system.' M Sc thesis, Department of Agronomy, Tamil Nadu Agricultural University, pp 1-99.
- Jat R S and Ahlawat I P S. 2004. Effect of vermicompost, biofertilizer and phosphorus on growth, yield and nutrient uptake by gram (*Cicer arietinum*) and their residual effect on fodder maize (*Zea mays*). *Indian Journal of Agricultural Sciences* **74** (7): 359-61.
- Jayanthi C, Rangasamy A and Chinnusamy C. 1997. Integrated nutrient management in rice based cropping system linked with lowland integrated farming system. *Fertilizer News* **42** (3): 25-30.
- Malewar G V, Badole S B, Mali C V and Siddiqui M B. 1999. Yield, NPK concentration and their uptake by sunflower and cotton as influenced by flyash with and without FYM and fertilizers. *Journal of Soil and Crops* **9** (1): 18-22.
- Misra B N, Yadav R S, Rajput A C and Pandey S M. 1994. Effect of plant geometry and nitrogen application on yield and quality of winter maize (*Zea mays* L.). *Indian Journal of Agronomy*, **39** (3): 468-9.
- Nanjappa H V, Ramachandrapa B K and Mallikajuna B O. 2000. Integrated nutrient management and residue incorporation in maize - potato sequence. (In) *Extended Summary, National Symposium on Agronomy: Challenges and Opportunities for the New Millennium*, 15-18 November 2001, GAU campus, Junagadh, pp 57-8.
- Pattanashetti V A, Agasimani C A and Babalad H B. 2002. Effect of organic Sources and fertilizer levels on growth, yield and yield attributes of soybean intercropped with maize in north transitional tract of Karnataka. *Karnataka Journal of Oilseeds Research* **19** (1): 113-4.
- Rajkhowa R J, Gogoi A K, Kandali R and Rajkhowa K M. 2000. Effect of vermicompost on green gram nutrition. *Journal of Indian Society of Soil Science* **48** (1): 207-8.
- Sahoo S C and Panda M M. 2000. Onfarm assessment of use of chemical fertilizer and FYM on the productivity of maize. *Annals of Agricultural Research* **21** (4): 677-80.
- Sharma A R and Mitra B N. 2007. Effect of different rates of application of organic security in harmony with nature. 1st - 4th December 1997, UAS, Bangalore.
- Subha K M and Gajendragiri R. 2004. Effect of integrated nutrient management on dry matter accumulation, nutrient content and uptake by sunflower. *Annals of Agricultural Research New Series* **25** (3): 398-402.