Production of Farm Waste Compost and Its Utilization for Yield Improvement of *Capsicum grossum* Willd. (Sweet pepper)

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Abstract

Investigation of the effects of rice straw composts on *Capsicum grossum* Willd. (sweet pepper) was conducted in Taungoo University Campus. Composting process was prepared from July, 2011 to February, 2012 and cultivation was carried out in March, 2012. Bin method was used in composting and rice straw waste was mixed with cowdung, with vermicompost and with legume residue in a ratio of 10:1 in weight-wise respectively. Composting periods was taken 210 days and the resting time was 23 days. Five treatments with three replicates were set up in Randomized Complete Block Design (RCBD). The optimum ranges of C/N ratio; 10.24 and 10.42 were observed in T_1 (compost of rice straw waste+ cowdung) and T_4 (compost of pure rice straw waste). Total nitrogen content of T_4 was the highest, 1.69%. T_1 (compost of rice straw waste+ cowdung) had the maximum mean plant height (22.99 cm), largest number of leaves (18.78), biggest leaf area (28.13 cm^2) and highest yield (121.58 g/ plant).

Keywords: *Capsicum grossum* Willd., bin method, Randomized Complete Block Design (RCBD), C/N ratio, yield

Introduction

Due to extensive and improper use of chemical fertilizers in the soil, our soil is degrading to an alarming level, causing an imbalance in the ecosystem and environmental pollution as well. To avoid these adverse effects and also for sustainable agriculture, one should rely on ecological oriented resource conserving technologies (Khan and Sarwar, 2002). Composting qualifies excellently as a rural technology, since it makes use of materials available locally and improves their utility (Berreveld, 1989). Composting, a biological treatment process, has long been practiced in many countries and is proven to be comparatively cheaper than many other treatment methods (Agamuthu, 2000).

Rice, as the largest crop, has a potential by-product in the form of rice straw. Some technical problem in conducting efficient small-scale composting under tropical conditions remains to be solved. Thus, there is a need for conducting research to adapt technologies for the most appropriate small-scale processing of residues (Shacklady, 1982). Utilization of agricultural by-products such as straw is becoming a priority issue because disposal practices such as open field burning are no longer environmentally acceptable. Utilization of these residues will require development of management systems such as low-input composting (Churchill *et al*., 1993). Hence, this study was aimed to study the process of compost from rice straw wastes, to investigate the most appropriate supplement in the process of rice straw compost, to introduce the application of rice straw waste compost in growing of sweet pepper, to substitute waste as fertilizer not only for aesthetic value to environment but also for cost reduction to farmers.

Materials and Methods

Composting of farm wastes (rice straw)

The fresh farm wastes (rice straw) were collected from the farms in Kanyutkwin, Phyu Township, Bago Region. Totally 4 wooden bins (60 cm x 60 cm x 60 cm) were used in this experiment. Preparing compost from the rice straw wastes was followed by the method of Barreveld, 1989. The farm wastes were weighed (3.08 kg each) and spread layer by layer inside the bins. The additives used in this study were cowdung, vermicompost and legume residue. The blending ratio of farm wastes and each additive was 10:1, on weight basis.

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Between two layers of farm wastes, a thin layer (0.31 kg each) of either cowdung or vermicompost or legume residue was spread. There were 7 layers of each farm wastes and additive; totally 14 layers within each bin. Net weight of constituents per bin was 21.56 kg of farm wastes and 2.15 kg of additives. According to Gaur and Mathur (1986), a layer of soil was spread over the surface of the compost pile and the bins were covered with opaque plastic sheets to hold and moisture to retain the heat (Figure 1.1). Turning was done in every two weeks according to National Academy of Science, 1976.

Figure 1.1 Preparing the farm wastes for composting

Stockpiling of compost

The composts were stockpiled 210 days after composting period. They were sun-dried for three hours and laid 23 days as the rest time to ensure maturity.

Analysis of raw wastes and composts

Raw farm wastes, and additives; cowdung, vermicompost, and legume residue and the resulted composts were analyzed in the Soil Laboratory, Land Use Division, Myanma Agriculture Service, Yangon Region.

Experimental layout

Four treatments such as T_1 = compost of farm waste with cowdung, T_2 = compost of farm waste with vermicompost, T_3 = compost of farm waste with legume residue, and T_4 = pure compost without additive each with three replicates were arranged in Randomized Completely Block Design (RCBD). A total of 60 plants were grown in the prepared compost medium. The spaces between plants were 60 cm and between rows were 75 cm. The total area of this experiment was 27 m^2.

Cultural management practices

The plants were watered every day. Weeding and pesticide (M-chlorocyper and Shwe San Fan) application were done whenever necessary.

Harvest and handling process

Sweet peppers were harvested from 2 months to 5 months after sowing. The fruits were cut off from the plants by using scissor.

Data collection and statistical analysis

The vegetative and reproductive characters such as plant height, number of leaves, length and width of leaves, number of fruits, and fruit weight were weekly collected from each treatment. The data were analyzed using the IRRISTAT software version 4, developed by International Rice Research Institute (IRRI), the Philippines.

Results

Characteristics of farm waste (rice straw) before composting

Rice straw has the high carbon: nitrogen ratio and among additives, cowdung has the lowest C/N ratio.

Table 1.1 Analyzed characteristics of raw materials for farm waste (rice straw) composting

	Moisture (%)	Total Carbon (%)	Total Nitrogen (%)	C/N
Farm waste (rice straw)	12.22	49.91	0.56	89.13
Cowdung	12. 37	10. 50	1. 19	8. 77
Vermicompost	6. 50	26. 09	1. 43	18. 24
Legume residue	8. 94	20. 23	1. 84	10. 96

Characteristics of farm waste (rice straw) after composting

In comparing with FFTC's standards of stability, all composts agreed with other standards except total organic matter and total nitrogen content in which they all are lower than the standards.

Table 1.2 Physical and chemical characteristics of farm waste (rice straw) composts from analysis

Physical and Chemical Characteristics	Farm waste (rice straw) composts				Condition for stability*
	Cowdung	Vermicompost	Legume residue	No additive	
Color	Dark brown				Dark brown
Odor	Earthy				Earthy
pH	7.37	7.40	7.46	8.08	Alkali
C/N	10.24	8.67	12.28	10.42	<20
Total carbon (%)	15.67	16.49	16.58	17.61	>5
Moisture(%)	6.48	6.15	6.70	7.59	<35
Total organic matter(%)	27.02	28.43	28.58	30.36	40
Total nitrogen (%)	1. 53	1. 67	1. 35	1. 69	2
Total P_2O_5	0. 99	1. 05	1. 13	1. 99	1
Total K_2O	3. 18	3. 70	3. 78	4. 96	1

*Food and Fertilizer Technology Center, Taiwan (2005)

Plant Height

T_1 (compost of farm waste + cowdung) possessed the maximum mean plant height of 22.99 cm, followed by T_4 (pure compost), 21.50 cm and the minimum from T_2 (compost of farm waste + vermicompost), 15.71cm was obtained (Table 1.4 and Figure 1.2).

Table 1.3 The plant height of *Capsium grossum* Willd. resulted from different farm waste (rice straw) composts

Treatment	Plant height (cm)						
	4 WK	5 WK	6 WK	7 WK	8 WK	9 WK	Mean
T_1 (Com+Cd)	8.49	13.82	20.24	25.82	30.99	38.62	22.99
T_2 (Com+Ver)	5.59	8.48	11.76	16.91	21.28	30.24	15.71
T_3(Com + Sdt)	5.67	8.68	12.93	18.99	24.33	32.61	17.20
T_4 (Pure com)	8.64	12.98	18.03	23.68	28.95	36.77	21.50
F-test	**	**	**	**	**	*	-
5% LSD	2.07	3.43	4.75	4.15	4.72	5.00	-
CV %	18.10	19.40	18.50	12.00	11.20	9.30	-

* = significant at $P \leq 0.05\%$, ** = significant at $P \leq 0.01\%$

Number of leaves

T_1 (compost of farm waste + cowdung) showed the largest number of leaves, 18.78, followed by T_4 (pure compost), 18.49 and T_2 (T_1 (compost of farm waste + vermicompost) showed the least number, 13.50 (Table 1.5 and Figure 1.3).

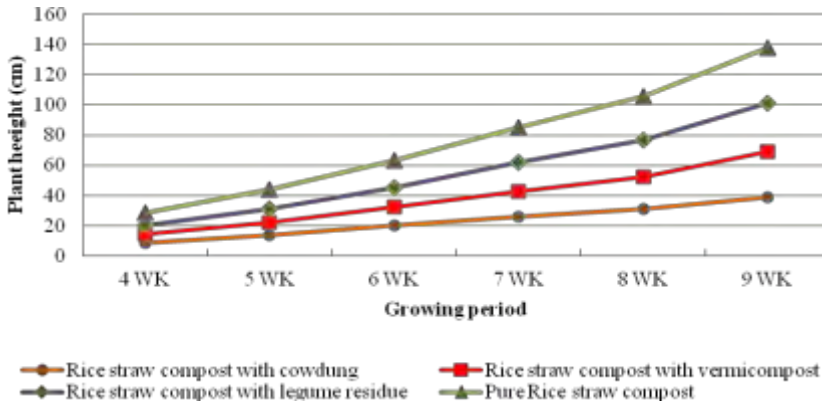

Figure 1.2 Effect of farm wastes (rice straw) composts on plant height of sweet pepper

Table 1.4 The number of leaves of *Capsium grossum* Willd. resulted from different farm waste (rice straw)composts

Treatment	Number of leaves						
	4 WK	5 WK	6 WK	7 WK	8 WK	9 WK	Mean
T_1 (Com+Cd)	6.83	9.33	14.58	18.74	27.58	35.66	18.78
T_2 (Com+Ver)	5.08	6.99	10.16	12.74	19.41	26.66	13.50
T_3(Com + Sdt)	5.49	7.49	10.58	14.33	21.91	32.74	15.42
T_4 (Pure com)	7.99	9.58	13.16	17.49	26.74	35.99	18.49
F-test	**	*	*	* *	*	ns	-
5% LSD	1.37	1.97	2.97	3.78	6.73	11.1	-
CV %	13.6	14.7	15.3	14.8	17.4	21.6	-

* = significant at P ≤ 0.05%, **= significant at P ≤ 0.01%, ns = non significant

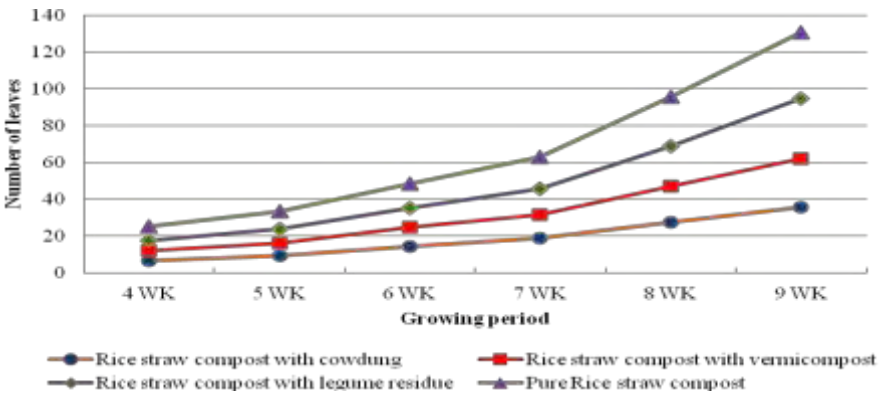

Figure 1.3 Effect of farm wastes (rice straw) composts on number of leaves of sweet pepper

Leaf area

T_1 (compost of farm waste + cowdung) had the broadest leaf area of 28.13 cm^2, followed by T_4 (pure compost), 25.77 cm^2 and T_2 (compost of farm waste + vermicompost) had the least value, 17.80 cm^2 (Table 1.6 and Figure 1.4).

Yield

Pod Yield per plant

T_1 (compost of farm waste + cowdung) had the highest yield of 5.75 number/ plant, followed by T4 (pure compost), 5.00 number/ plant and T_2 (compost of farm waste + vermicompost) had the most inferior result, 3.75 number/ plant.

Table 1.5 Leaf areas of *Capsium grossum* Willd. resulted from different farm waste (rice straw) composts

Treatment	Leaf area (cm^2)						
	4 WK	5 WK	6 WK	7 WK	8 WK	9 WK	Mean
T_1 (Com+Cd)	5.62	10.87	22.56	35.42	41.38	52.95	28.13
T_2 (Com+Ver)	2.03	3.83	11.33	22.05	30.05	37.54	17.80
T_3(Com + Sdt)	2.62	5.05	16.11	27.17	37.39	43.71	22.00
T_4 (Pure com)	6.76	11.45	21.41	31.43	38.04	45.66	25.77
F-test	*	**	**	**	*	ns	-
5% LSD	3.71	6.01	8.34	7.93	9.24	11.7	-
CV %	49.7	40	26.4	16.1	15.3	16.3	-

* = significant at P ≤ 0.05%, **= significant at P ≤ 0.01%, ns = non significant

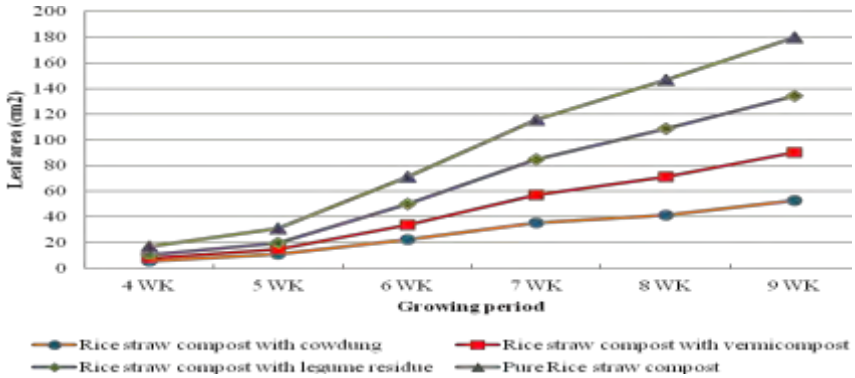

Figure 1.4 Effect of farm wastes (rice straw) composts on leaf area of sweet pepper

Yield (g) per plant

T_1 also had highest yield, 121.58 g/plant, followed by T_4 (pure compost), 100.50 g/plant and T_3 (compost +legume residue) had the most inferior result, 79.50 g/plant (Table 1.7, Figure 1.5).

Table 1.6 Yield per plant of *Capsicum grossum* Willd. resulted from different farm waste (rice straw) composts

Treatment	Yield (pod/plant)	Yield (g/plant)
T1 (compost + cowdung)	5.75	121.58
T2 (compost + vermicompost)	3.75	81.75
T3 (compost +legume residue)	4.25	79.50
T4 (pure compost)	5.00	100.50
F-test	ns	**
5% LSD	3.07	1.35
CV%	41.6	37.7

** = significant at P ≤ 0.01 % ns = non significant

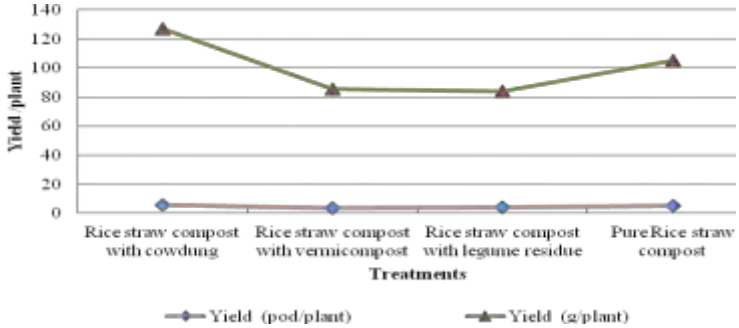

Figure 1.5 Effect of farm wastes (rice straw) composts on yield of sweet pepper

Discussion and Conclusion

In this experiment, compost of farm waste (rice straw) was prepared by adding with three additives such as cow dung, vermicompost and legume residue. N, P, K contents and C/N ratio of composts were recorded. These composts were used in growing of sweet pepper for evaluation of the effect of composts on the plant growth and yield. The results showed that T_1 (compost of farm waste + cowdung) gave the best yield and maximum number of leaves of *Capsicum grossum* Willd. cv. sweet pepper.

When compared the carbon contents, all of the treatments were in accordance with the report of FFTC (2005). In this report the carbon must be greater than 5 for condition for stability. When compared the nitrogen contents, all composts have lower values while the report of FFTC (2005) mentioned that the final nitrogen contents of 2 has been suggested as ideal. Regarding to C/N ratio, the maximum C/N ratio observed in T_3 (compost with legume residue) being 12. 28 and the most desirable C/N ratio observed in T_1 (compost with cowdung) was 10. 24. The report of FFTC (2005) mentioned that the final C/N ratio of 15 to 20 will be expected and the value of 10 has been suggested as ideal. C/N ratio of T_1 approached the ideal standard; 10 the most. It is supposed to be this is the reason that T_1 gave the best results in both growth and yield although T_4 has more nitrogen and organic matter content than T_1. Therefore, compost with cowdung of this experiment was effective for growing of plants especially for sweet pepper.

It can be concluded that rice straw waste compost can be applied in growing of sweet pepper, cowdung is the supplement that is more appropriate rather than vermicompost and legume residue in the process of rice straw compost, and cowdung, the lower C/N material as the additive should be added with high ratio.

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