

Organic Fertilizer Effects on the Yield and Biological Activities of *Curcuma longa* L.

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Objectives

Curcuma longa L.(turmeric) has been used for preparing traditional Indian curries for hundreds of years as a flavor, color, and preservative. Recently, the demands on rhizome of turmeric are increasing greatly by well-being boom, but there is not enough to meet the demands. To fulfill increasing demands, cultivation system strategies using the organic fertilizers are required to produce a greater amount of rhizome with good quality and yield. A field experiment was conducted to determine the effect of composts, NPK fertilizer(F), swine manure(SM) and fermentation manure from the wasted oriental medicine materials(OMWM), on rhizome yield and the content of bioactive components for quality.

Materials and Methods

- Treatments and management: Soil texture was silt loam. Composts, swine manure(SM) and fermentation manure from the wasted oriental medicine materials(OMWM), was applied at rates of 30 and 30 ton ha⁻¹ respectively. Younger rhizome were transplanted on May 3, 2007 and harvested on November 20, 2007.
- Functional compost: -wasted oriental medicine materials, -supplied microbe strains[KB, *Bacillus* sp.(5 ea), *Lactobacillus* sp.(3 ea)]; - fermented for 60 days, chemical properties of compost
- Analysis of inorganic soil and plant constituents: organic matter content (Wakley and Black method), total nitrogen content(Kjeldahl digestion method) etc.
- Analysis of curcumin: A known weight of fresh rhizome was ground in ethanol and diluted further in ethanol. A standard curve was prepared at different concentration from pure curcumin and absorbance recorded spectrophotometrically (peak absorption at 430 nm) on Spectronic 21D

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- Total polyphenol contents: Total phenol content was determined colorimetrically by the Folin - Ciocalteu method(1912) as modified by Lamuela-Raventos et al(1999).
- Flavonoid contents: Moreno et al.(2000) methods, standard(quercetin)
- Antioxidant contents: DPPH(1,1-diphenyl-2-picrylhydrazyl) methods(Blois, 1958)
- Statistical analysis: All data were analyzed statistically by an analysis of variance using CoStat software(CoHort Software, Monterey, USA). Mean comparisons were conducted using an ANOVA protected least significant difference(LSD) ($P < 0.05$) test

Results

Our results showed that two compost applications can increase both rhizomes(24.1-25.9%) and curcumin(21.7-41.0%) yields, respectively, compared to F. SM and OMWM application also increased the total phenol yields 7.8 and 8.7 g/10a compared with F 6.3 g/10a, the flavonoid yields 6.3 and 7.3 g/10a compared with F 5.3 g/10a, and also antioxidant activity 21.7 and 41%, respectively, as compared to the F. Especially, OMWM was more effective in total rhizomes yields and bioactivities and in the biosynthesis of curcumin and bioactive components than SM treatments, but the biological pathway was not clear, still. This experiment suggests that curcumin or bioactive components affected by adding SM and OMWM could increase the yields and quality of turmeric.

Table 1. Growth characteristics of the turmeric as affected by different organic manure.

Treatment	Plant height (cm)	No. leaf (no./plant)	Leaf width (cm)	Leaf length (cm)	Root length (cm)	Root diameter (cm)	No. bulb (no./plant)	Leaf color(SPAD reading)
Fertilizer(F)	102	7.3	14.0b	42.5	6.3	22	7.6	34.1b
F+SM ^{b)}	109	7.6	14.8a	45.3	6.9	23	8.3	36.3a
F+OMWM ^{c)}	106	8.0	14.8a	44.9	6.7	22	8.0	37.3a
LSD _{0.05} ^{a)}	6.7	0.94	0.62	2.8	0.72	1.5	0.94	2.1

^{a)}LSD_{0.05}=least significant difference at probability level of 5%.

^{b)}SM: Swine manure

^{c)}OMWM: fermentation manure from wasted oriental medicine materials.