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Commercial Organic Fertilizers and their Labeling in Malaysia

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ABSTRACT

Organic and sustainable farming systems require organic fertilizer as an organic input to sustain soil fertility. As organic fertilizers (OF) are complex and variable, their selection is important since it has a direct influence on the organic produce. Thirty five bags of commercially available OF were obtained from Klang Valley, Selangor and Seremban. The OF were grouped as: a) oil-palm wastes base (OP), b) plant base (P), c) manure base (M), d) plant and manure base (P+M) and e) vermicompost (VC) based on the method of composting and f) unknown (UKN) when the source of material was not known (either from the labels or the suppliers). From this study it is suggested that by adopting uniform definitions, fertilizer manufacturer would be able to designate products that are suitable for organic production. The Department of Agriculture (DOA) should also have proper guidelines on the quality of OF for safe use in the organic farming system especially on adjustment of fertilizer terms and information on the labels. This may reduce the confusion caused by multiple definitions of the word 'organic'. Organic fertilizer standards are recommended in order to produce high quality organic fertilizers for organic production in Malaysia.

Keywords: labeling, organic fertilizer, organic farming, Malaysian Organic Certification

INTRODUCTION

One of the strategies in the Third National Agriculture Policy (NAP3) of Malaysia is to transform food agribusiness industry into a competitive sector producing safe and quality products through sustainable farming systems e.g., good agriculture practices (SALM, Skim Amalan Ladang Malaysia) and organic farming (Faridah 2001). According to the International Federation of Organic Movement (IFOAM), organic farming is an agriculture system that promotes environmentally, socially and economically sound production of food and fibers which reduce external inputs by refraining from the use of chemo-synthetic fertilizers, pesticides and pharmaceuticals. The growth of organics in Malaysia is reflected in the increasing

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number of organic farmers, processors, retailers, consumers and suppliers. The Malaysian Organic Certification Program or *Sijil Organik Malaysia* (SOM) was launched in 2003 to facilitate the growth of organic farming in Malaysia and to certify organic farmers and entrepreneurs according to the requirements of the Malaysian Standard MS1529. The certification is also expected to increase the competitiveness of Malaysian organic produce in the local and foreign markets. It is estimated that there are about 42 certified holders occupying 1130 ha of agricultural land under organic farming system in 2010 (DOA 2011) focusing mainly on production of vegetables, herbs, medicinal plants and fruits and a few in integrated farming with mix cropping, aquaculture and animal husbandry. Organic and sustainable farming systems require organic fertilizer as an organic input to sustain soil fertility. According to IFOAM organic fertilizers (OF) are farm wastes comprising mainly of crop residues, animal manures, compost, green manures and residues from processing of plant, animal products and sewage sludge.

Many researchers have reported on the benefits of OF. Organic fertilizers (i) enhance soil biological activity which improves nutrient mobilization from organic and chemical sources and decomposition of toxic substances; (ii) promote the colonization of mycorrhizae, which improves P supply; (iii) promote root growth due to better soil structure; (iv) increase soil organic matter content (SOM); (v) improves the exchange capacity of nutrients; (vi) increase soil water retention; and (vii) promotes soil aggregates and buffering capacity (Lal *et al.* 1998; Herrick and Wander 1998; Seybold *et al.* 1998.). However, the composition of OF is complex and variable and behaves differently when applied to soil due to its contents. The selection of OF is important, since it has a direct influence on the organic produce. Undecomposed OF, that is, municipal waste sludge, which has high ammonium (NH_4^+), organic acids and heavy metals may influence vegetative growth and is phytotoxic when consumed (Zucconi *et al.* 1981; Wong 1985). Unstabilized OF with high C/N ratio immobilize significant amounts of N, making it unavailable for plant utilization and resulting in deficiency problems (Tognetti *et al.* 2007).

Currently in Malaysia, composting process is recognized as the most adequate pre-treatment in order to obtain a composted material which may respond more efficiently and safely than the raw material to soil. There are also a few manufacturers who formulate fertilizers for organic agriculture systems that are composed of dehydrated granular by-products of animal production such as feather meal, bone meal and poultry litter, plus other mined sources of P, K and some micronutrients.

According to Bernal *et al.* (2009) and Zucconi and de Bertoldi (1987), the quality criteria of compost are established in terms of (i) nutrient content, (ii) humified and stabilized organic matter, (iii) the maturity degree, (iv) the sanitation and (v) the presence of certain toxic compounds such as heavy metals, soluble salts and xenobiotiocs. However, the characterization of composted materials is still quite unclear and no uniformity exists on what properties should be tested and graded for evaluation and specification of the quality of composts as organic fertilizer. As organic fertilizer source becomes more diverse, this problem becomes more severe and the procedures of defining guidelines for production and safe usage are becoming more complex to establish. The problem is compounded by the common practice of mixing diverse wastes types, in order to achieve optimal carbon, nitrogen and phosphorus as nutrient source.

Inorganic chemical fertilizers have N, P, K content on the labels according to rules established more than half a century ago. However, organic fertilizers or compost, products that contains nutrients and organic matter, is not subjected to any systematic rules for reporting content, qualities or potential risks. There are no labeling rules and no published guidelines established by the Department of Agriculture in Malaysia. The term 'organic when used on a OF label', means: "that the claim of the product, compound, mix of compounds or constituent to be organic has been allowed or allowed with restriction by the SOM regulations". Certified organic farmers who inadvertently apply organic fertilizers labeled as 'organic' that contain materials prohibited for use in organic production may lose their organic certification, with ensuing loss of income. If uniform definitions are adopted, fertilizer manufacturers would be able to designate products that are suitable for organic production. Therefore buyers are clearly in a position to determine which products are suitable for use under organic certification. In addition, consistent use of the word 'organic' would aid farmers seeking products that will not compromise their organic certification status. Therefore this study was conducted to determine (a) the consistency of the information (fertilizer grades, 'organic' terms used, fertilizer application rates etc.) on the labels of OFs as an input for organic production and the physico-chemical properties of OFs varying in their source materials and b) comparison of organic fertilizer and compost with a few standards that is, Official Fertilizer Standards of Korea (2001), EEC - (1998) organic rule, and European Eco-label Standard (OJ 1998).

MATERIALS AND METHODS

Thirty five bags of commercially available organic fertilizers (OFs) were obtained from Klang Valley, Selangor and Seremban. The OFs were grouped as: a) oil-palm wastes base (OP), b) plant base (P), c) manure base (M), d) plant and manure base (P+M) and e) vermicompost (VC) based on the method of composting and f) unknown (UKN) when the source of material was not known (either from the labels or the suppliers). Samples (300 – 600 g) of the organic fertilizers were dried at 65 ^{o}C for 3 days and sieved to < 5 mm and ground to < 2 mm. These samples were stored at room temperature until analysis. The physico-chemical properties analyzed were as follows; pH and EC was determined in the suspension of 1:5 (water: OF) using pH-meter (Mettler MP 225) and EC meter, respectively. Moisture content was determined by gravimetric method whereby 10 g of air-dried OF was placed in the oven at 105 ^{0}C for 24 hours. The samples were then removed from the oven and placed at room temperature to cool off. The weight of the oven-dried fertilizer was recorded. Organic C was determined according to the combustion method (McKeague 1976). One gram of OF was placed in a crucible and put into a furnace at 350 ^{0}C for an hour. The temperature was then raised to 550 ^{0}C and left for 5 hours. The remaining ash was weighed and organic C was calculated from the loss in weight during the ashing process. Organic matter (OM) content was calculated from loss on ignition (correction factor of 1.78). Total N was determined using the Kjeldhal method (Bremner and Mulvaney 1982). Total analysis of the heavy metals and macronutrients were determined using the aqua-regia method. The extraction solution was made using HCl and HNO_3 solution (3:1). Heavy metals (Pb, Cd, Cu, Ni, Mn, Zn, and Fe) and macronutrients (Mg, Ca and K) in the solution were determined using the atomic absorption spectrophotometer, Model PE 5100. Lignin and cellulose was determined using Van Soest (1967) method. All experimental data were analysed statistically using analysis of GLM variance (ANOVA). Duncan's multiple range test (DMRT) was used for comparison of treatment means when F values were significant at $p<0.05$.

RESULTS AND DISCUSSION

Details of the commercial organic fertilizers and information on the labels are presented in Table 1. The OFs generally had gone through composting process especially oil palm waste compost and vermicompost. Out of 35 bags, 51% of the OFs had the term 'organic', 43% 'bio-organic' and 3% semi-organic and bio-organon, respectively on their lables. Though 74% of the OFs collected had information on nutrient contents, only 14% had the fertilizer grades stated on the labels. In relation to trace elements, 64% had such information and 94% had recommended use and rates of application, for example, for vegetables, fruits, nursery, greens and potted plants. However only 74 % of the OFs had additional information, for example, benefits of OFs to soil.

From this study, we observed that OFs derived from oil palm wastes (OP) have meaningful labels. This could be due to the fact that the consumers that purchase these OFs are big scale farmers either from organic or sustainable farming system. However, the UKN, P and P+M based OFs do not have sufficient information on the labels for the use of farmers. Small farmers whose acreage is small and backyard gardeners who have common understanding of 'organic food' are especially vulnerable to misleading or confusing fertilizer labels. Therefore, it is suggested that the labels of OFs should be verified. According to Eggerth *et al.* (2007), labeling of fertilizers in the United States is an important legal constraint that is not oriented to health. It prohibits the use of 'fertilizer' term on the label of a product that has a combined concentration of N, P, and K that is lower than than 6%. The types of terms permitted are 'soil amendment', 'soil conditioner', or simply 'compost'. The Department of Agriculture (DOA) should have proper guidelines on the quality of OFs for safe use in organic farming system especially, and provide guidelines for use of fertilizer terminologies and information on the labels. This may reduce the confusion caused by multiple definitions of the word 'organic'. The DOA could also issue seal of quality, such as the European Eco-Label Standard (OJ 1998) seal to organic fertilizer producers whose products meet the guidelines of quality organic fertilizer and standard labeling. According

TABLE 1

Details of the commercial organic fertilizer collected and information on the labels

Ingredients and composting details	organic term	nutrient information	trace elements	purpose and rates	additional information	fertilizer code
Composted, oil palm waste, medium grade	bio-organic	√	√	√	√	OP1
Composted, oil palm waste,	Organic	√	√	√	√	OP2
Composted, oil palm waste	Organic	√	√	√	√	OP3
Composted, oil palm waste,	Organic	√	√	√	√	OP4
Composted, oil palm waste,	bio-organic	√	√	√	√	OP5
Composted, oil palm waste , commercial grade	bio-organic	√	√	√	√	OP6
Composted, oil palm waste, with mycohrizae	semi-organic	8-2-5	√	√	√	OP7
Composted, oil palm waste	bio-organic K	2-6-6	√	√	√	OP8
Composted, oil palm waste,	organic	√	√	√	√	OP9
Composted, oil palm waste, pH 10	bio-organon	2-3-11	√	√	√	OP10
Vermicompost, 70% spent mushroom and 30% cattle manure	bio-organic	√	√	√	√	VC1
Vermicompost, empty fruit bunches and cattle manure	organic	√	√	√	√	VC2
Vermicompost, 60% saw dust and 40% cattle manure	bio-organic	√	√	√	√	VC3
Vermicompost, 70% sawdust and 30% cattle manure	bio-organic	NA	NA	√	NA	VC4
Vermicompost, 60% saw dust and 10% goat manure	organic	NA	NA	√	NA	VC5
Vermicompost, 50% manure and 50% paddy straw	organic	√	√	√	√	VC6
Vermicompost, 90% cattle manure and saw dust	organic	√	√	√	√	VC7
Vermicompost, 90% cattle manure and saw dust (added microb)	organic	√	√	√	√	VC8
Vermicompost, 90% cattle manure ,saw dust, P fertilizer	organic	√	√	√	√	VC9
Plant base, matured compost	organic	√	√	√	√	P1
Plant base, paddy straw fermented	bio-organic	NA	NA	NA	NA	P2
Plant base, multi strain	bio-organic	√	NA	NA	√	P3
Plant base	organic	NA	NA	√	NA	P4
Plant base	bio-organic	8-8-8	√	√	NA	P5
Plant base	bio-organic	4-3-2	√	√	√	P6
Fermented plant and animal wastes	bio-organic	NA	NA	√	NA	PM1
Plant and animal waste	bio-organic	NA	NA	√	NA	PM2
Cow Manure and Plant Waste Compost	organic	NA	NA	√	√	PM3
Farm yard manure	organic	√	√	√	√	M1
Poultry manure	bio-organic	NA	NA	√	√	M2
Goat Manure	organic	√	√	√	√	M3
Goat Manure (100%)	bio-organic	√	√	√	√	M4
Organic fertilizer	organic	NA	NA	√	NA	UKN1
Organic fertilizer blue	organic	√	NA	√	NA	UKN2
Organic fertilizer	organic	√	NA	√	√	UKN3

NA - Non Available

to the Official Fertilizer Standards of Korea, (2001), organic fertilizers are mainly from residues of plant and animals whereas the by-product fertilizers are mainly from by-product of fisheries, agriculture and related industries, manure and food wastes.

The range of physico-chemical properties of the 35 commercial organic fertilizers are presented in Table 2. Percentage of organic matter (OM) varied widely from 25 to 79 % which is more than required by the Official Fertilizer Standards of Korea (2001) for by-product fertilizer (> 20 %). However there are no regulations on the type and amount of organic matter for organic fertilizers. According to the Official Fertilizer Standards of Korea (2001), fertilizers with C/N ratio 15 to 20 are accepted as organic fertilizers, whereas those with higher C/N ratios (20 to 35) are considered as compost or by-product fertilizer. The C/N ratio of organic fertilizers in this study ranged from 3.8 to 42.7. Total organic C of commercial organic fertilizers ranged from 8.4 to 45 % and total N values were from 0.7 to 4.4 %. According to the Official Fertilizer Standards of Korea (2001), for by-product fertilizer are concerned with the content of organic matter and not the nutrients; however standards for organic fertilizers are focused mainly on the nutrient contents. Total nutrient content of fertilizers labeled as 'organic' should be within 5 to 20 % (N > 4%, P_2O_5 > 1% and K_2O > 1%) according to Official Fertilizer Standards of Korea (2001). In this study, commercial OFs had concentration of P ranging from 0.01 to 8.9%, K from 1.3 to 6.9 %, Ca from 0.1 to 1.6 % and Mg ranging from 0.3 to 3.3 %. However none of these fertilizers qualify as organic fertilizers except for P6 (according to Official Fertilizer Standards of Korea, 2001). Furthermore, the NPK grades stated on the labels of OP7, OP8, OP10, P5 and P6 were lower than the results obtained from the analysis.

According to the US labeling rules (Eggerth *et al.* 2007), 51.4% of the commercial organic fertilizers studied (mainly vermicompost) had total NPK content more than 6% and only qualify as a compost product with the term 'fertilizer' on the labels Whereas the remaining 48.6 % of OFs could only be labeled as 'soil improver' or 'soil amendment' and not as 'organic fertilizers'. Generally the micronutrient contents (Zn and Cu) were within the permitted levels in the OFs by EEC-(1998) organic rules, Official Fertilizer Standards of Korea (2001) and the European Eco-Label Standards (OJ 1998) applicable for compost. Moreover traces of Co, Cd and Pb were not detectable in the OFs samples.

Commercial organic fertilizers in this study had lignin and cellulose content ranging from 5.3 to 67 % and 9.3 to 29 %, respectively. However, the pH and EC values ranged from 4.5 to 9.8 and 0.08 to 12.3 dS m^{-1}, respectively. The OFs were classified according to their source materials in order to examine whether this may be a determining factor for their differences (Table 3). The physico-chemical properties of OFs in this study did not vary greatly when grouped according to the source of materials and production method. There were no significant differences in the pH, EC, TOC, lignin, cellulose, K, Ca, Mg and Mn content among the fertilizers. The percentage of OM was higher in P (62.7 %), M (56.7 %), UKN (57.7 %) and P+M (47.3 %) compared to OP (39.9 %) and VC (31 %) organic fertilizers. Total

TABLE 2

Range of physico- chemical properties of 35 commercial organic fertilizers in Malaysia.

	pH (1:5)	EC (dS m^{-1})	C/N	O.M	TOC	Lignin	TN	Cellulose	P	K	Ca	Mg	Zn	Cu	Mn	Fe
				%									mg kg $^{-1}$			
Maximum	9.8	12.28	42.7	79	45.0	67.0	4.4	29.1	8.85	6.94	12.00	3.3	353	88	827	24740
Minimum	4.5	0.08	3.8	25	8.4	5.3	0.7	9.3	0.04	1.29	0.12	0.3	45	17	89	912
Average	6.9	2.10	13.0	46	19.1	16.8	1.7	19.1	1.70	2.82	1.68	1.0	134	47	315	8602
SD[a]	1.3	2.76	7.2	16	7.9	10.8	0.8	6.0	2.02	1.70	3.00	0.8	70	17	200	5691

[a] - Standard Deviation

TABLE 3

Physico-chemical properties of commercial organic fertilizers according to source of materials

	OP (n=10)	VC (n=9)	P (n=6)	P+M (n=3)	M (n=4)	UKN (n=3)
pH (1:5)	7.3ab	6.1b	6.6ab	7.5ab	6.9ab	8.2a
EC (dS m^{-1})	1.1a	1.4a	4.1a	2.4a	2.2a	3.1a
C/N	11.6ab	9.8b	20.9a	13.3ab	10.5b	14.1ab
O.M (%)	40bc	31c	63a	47ab	57a	58a
TOC (%)	15a	18a	26a	16a	23a	19a
Lignin (%)	15a	19a	23a	13a	14a	11a
TN (%)	1.4b	1.9ab	1.8ab	1.2b	2.6a	1.6ab
Cellulose (%)	19.9a	18.2a	17.8a	16.4a	20.2a	23.1a
P (%)	0.8b	3.9a	0.9b	0.8b	1.3b	1.1b
K (%)	1.32a	3.30a	2.99a	1.76a	1.30a	3.15a
Ca (%)	1.01a	0.90 a	3.06a	2.55a	2.61a	6.94a
Mg (%)	0.34 a	1.3 a	0.5 a	0.6 a	0.9 a	1.0 a
Zn (mg kg^{-1})	97b	107b	129b	170b	165b	268a
Cu (mg kg^{-1})	56a	38ab	48ab	56a	31b	48ab
Mn (mg kg^{-1})	240a	318a	265a	525a	443a	275a
Fe (mg kg^{-1})	10960 a	8548 b	7606 b	11030 a	5268 b	4912 b
Pb (mg kg^{-1})	nd	nd	nd	nd	nd	nd
Co (mg kg^{-1})	nd	nd	nd	nd	nd	nd
Cd (mg kg^{-1})	nd	nd	nd	nd	nd	nd

nd - not detectable

Means with different letters within the row indicate significant differences ($p < 0.05$) using Duncan's Multiple Range Test.

N content was higher in M (2.6%) followed by VC (1.9%), P (1.8 %) and UKN (1.6 %) compared to OP (1.4 %) and P+M (1.2 %) organic fertilizers.

The phosphorus (P) content was highest in the vermicompost (3.9 %) compared to other OFs and the increase could be due to the addition of phosphate rock in vermicompost. According to Vivek and Singh (2001), addition of phosphate rock, N-fixing bacteria and P-solubilizing bacteria increased total N and total P in vermicompost after 75 days. The NPK of an OF is a function of the NPK of the wastes from which the fertilizer or compost is produced. In this study, due to low nutrient content in these fertilizers, it would be misleading to name these fertilizers as 'organic'. Therefore, grading is recommended to ensure the most effective and satisfactory utilization of the product. Low graded fertilizers would only be adequate for land reclamation. On the other hand, a high grade fertilizer could be applied for crop production. Guidelines have been set by DOA on the fertilizer inputs safe to be used for organic farming systems; however, there are no rules on the minimum requirement of nutrients (macro and micro) for fertilizers to be labeled as 'organic'. Though the micronutrient contents were below the levels permitted by EEC-1998 organic rules for organic production, the macro nutrient content were still low and could only be graded as compost, soil improver or soil conditioner and not as an organic fertilizer.

CONCLUSION

The Department of Agricultural of Malaysia should set guidelines for the labeling of organic fertilizers, such as the fertilizer terms, guaranteed analysis, fertilizer grade, application rates, especially for organic fertilizers. By adopting uniform definitions, fertilizer manufacturers would be able to designate products that are suitable for organic production and buyers would be able to clearly determine which products are suitable for use under organic certification. Organic fertilizer standards are also recommended in order to produce high quality organic fertilizers for organic production in Malaysia.

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