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Organic Fertilizers Derived from Farm By-Products for Sustainable Agriculture. – A Review

Saioof H –Kattoof*; A. M. El-Ghamry; K. F. Fouda and Sally F. Abo El-Ezz

Soil Science Dept., Faculty of Agriculture, Mansoura University, (Egypt)

ABSTRACT

The purpose of this research was to replace the term of "Agricultural Wastes" by the term "Agricultural By-products", since waste is a word indicates to a material useless that usually cannot be recycled or reused again. However, agricultural by-products are not only important in the agricultural field, but also important for the production of wharf, black coal, fuel and others. The usage of agricultural by-products become of important concern in the field of fertilization through composting such as agricultural by-products beside of reclamation of the desert soils which suffer from their low organic matter content. Furthermore, organic by-product can be used for mulshing which can reduce of loss of water by evapotranspiration. Moreover, tendency, towards organic agriculture and sustainable became agriculture amecessty to maintain soils fertility, safety, health and consequently the agricultural environment.

Keywords: organic, fertilizers, farm by-products, sustainable, agricuture

INTRODUCTION

In recent years, the application of organic fertilizers has received great attention from researchers investigating the sustainability and productivity of agricultural soils. Addition of organic matter like compost represents exognous inputs that are thought to primarily influence nutrient supply. Organic growing medium amendments usually are derived from plants or plant products that occur naturally or are the by-products of processing plants (sawdust -biogas- rice hulls) or waste disposal plants (compost, sewage sludge) (Hue,1995). The most important organic soil amendments world wide is compost and animal dung, which are most often easily, available and economically affordable.

Agricultural by-products (wastes) are defined as the residues from the growing plants and processing of raw agricultural products such as fruits, vegetables, meat, poultry, and dairy products. These agricultural by-products were supposed to be wastes of no or low economic value. Utilities of these by-products were thought to be not worth their cost of collection, transportation, and processing for beneficial use. The composition of the agricultural by-products depends on the system and type of agricultural activities and whether is found in the form of liquids, slurries, or solids.

Agricultural wastes, otherwise called agro-waste, consist of animal wastes (e.g. urine and dung), food processing waste (e.g. only 20% of maize is canned and 80% is waste), crop waste (corn stalks, sugarcane bagasse, drops and culls from fruits and vegetables) and hazardous toxic agricultural wastes (pesticides, e.g. insecticides and herbicides, etc.).

As agriculture expands, there with be more agricultural by-products. About 998 million tons of agricultural by-products are produced yearly (Agamuthu, 2009) and organic products can reach 80 percent of the total solid agricultural by-products in any farm (Brown, and Root, 1997). Total solid agricultural by-products in any farm reaches up to 5.27 kg / day / 1000 kg live weight, on a wet weight basis (Overcash, 1973). Organic matter in the soil is composed of hydrogen, oxygen, phosphorus, nitrogen and sulfur, which are necessary for plant growth. Organic matter is the mainSource of nitrogen and sulfur in the soil. The most important type of organic matter in the soil is the agricultural by-products (residues of dead or living plants) beside of the by-products decomposers e.g. bacteria, fungi, actinomycetes and others. The other type, that represents organic matter is, fat, wax and lignin, which are known as organic colloids and found in the soil as a very complex set of compounds. The secretions of plants and, decomposition of animals and their wastes are considered as organic soil material (Singer and Munns, 1987). Because It is important nowadays to improve soil health by providing the much needed of organic matter, continuous farming decreases soil nutrient contents and therefore there is possibility to recycle a variety of resources in agriculture is, where the use of agricultural by-products can engender tremendous benefits to the environment. Composting of solid agricultural by-products can also be considered as a source of the organic nutrients a source (Prakash, *et al*., 2007).

Farm residues as well as the integrated processing and management of soil through composting (Xi, *et al*., 2005 and El-Ghamry, *et al*., 2015) can importantly soil properties. Determining quality standards for organic farming can be a difficult task because of the heterogeneity of aggregated by- products.

* **Corresponding author.**
E-mail address: seoofhomed@gmail.com
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Why is replaced the term agricultural wastes by the term agricultural by-products?

Farm residues are commonly referred to an agricultural by-products. These wastes chiefly take the form of crop residues (residual stalks, straw, leaves, roots, husks, shells etcetera) and animal by-product (manures).

Agricultural by-products are widely available, renewable and virtually free, hence they can be reused as important resource (Westerman and Bicudo, 2005). These agricultural by-products can be converted into heat, steam, charcoal, methanol, ethanol, bio diesel as well as raw materials (animal feed, composting, energy and biogas construction).

In spite of the benefits of agricultural by-products, there is lack of a strategy to benefit from them, where the exploitation is simple and sometimes neglected and left to rot or burn. It is known that these byproducts contain a proportion of high levels of nutrients i.e. NPK that will improve the properties of the soil. It also increases the crop yields such as vegetables and corn, which in turn lead to enhance food security and also important for reducing the accumulation rate wastes, consequently reducing the environmental pollution. (Amoding, 2007).

Manufacturing composting the agricultural by-products .

Compost is defined as agricultural by-products having a high Level content of biodegradable organic ingredients, which is carried out by specialized bacteria and other microorganisms.

Compost is used to improve the soil properties such as structure so it is not only fertilizer in sufficient quantities to obtain high quality productivity but also to keep soil health (El-Ghamry, 2011). Fungi, actinomycetes and bacteria are decompose the organic materials in agricultural by-products directly. During composting, the organic matter is disintegrated down by microorganisms and forms carbon dioxide, water, energy and humus which is considered a stable product and final product of compost formation. (Avcioglu, *et al*., 2011).

Many factors play an important and active role in this process i.e. C/N ratio humidity and temperature. Controlling and optimizing the operating conditions, nutrients loss during composting can be also reduced to a minimum level as well as composting time (Avcioglu, *et al*., 2011).

Effect of plant by-products additives

After harvesting of crops, parts of plants are left to be called agricultural by-products, which are a good source of soil nutrients . Itis not a waste, while it is a good natural resource. The largest part of the crop contains carbon and other nutrients in large quantities for sustainable agriculture. Agricultural by-products are not wasted but are a supplier of basic environmental services, ensuring the continuity of the agricultural system (Smil, 1999).

Agricultural by-products are decayed as organic matter in the fields after harvest, such as corn stalks and husks, and most likely have more carbon than the crop itself (Liu, *et al*. 2006).

Characteristics of agricultural by-products

Agricultural by-products are characterized by low digestibility, lowmetabolic content, low crude protein content and low minerals and vitamins content. Agricultural by-products are a vital natural resource foraminate soil productivity and soil conservation (Rinehart, 2008 and Kubkomawa, *et al*., 2015). Integration effect of addition of agricultural of by-products to improve physical, chemical and biological soil conditions and prevent soil from degradation (Kurchania, 2012).

Effect of compost on plant growth and yield quality.

The use of organic matter (compost) in cultivated lands provides the soil not only by nutrients but also other positively influences such as soil particle aggregation, infiltration and water retention capacity (Pagliai, *et al*. 2004). Soil is essential to maintain soil fertility, which is reflexed on the plant growth and yield quality. Application of organic fertilizers could play an important role in providing plants with vital nutrients which have capability to promote growth giving stimulatory effect for plant and microbial growth (Sellim and Mosa, 2012, Farid *et al*., 2014 and Mosa. al. et., 2018). Agricultural by- products of animal and plant origins are a source of high practical value to enhance and promote crop productivity directly or indirectly, while indirect effect to the plant growth may be due to the increasing availability of nutrients that enhances the activity of microorganisms associated with the roots of crops and in turn helps to promote direct growth with the production of a hormones and oxen`s that help plant to grow and dissolve the essential nutrients to be more available for plant (Maheshwari, 2013).

The increase of organic matter has several important benefits when add to the soil, on its physical chemical, and biological properties. In addition, organic matter contributes effectively to the productivity of soil through its aeration, seed germination and improvement of plant root extension (Edwards and Hailu, 2011). Organic materials increased the growth characters, grain as well as straw yields, too-grain weight and increased the chlorophyll content in barley leaves (Bereez *et al*., 2005 and Gaballa & El-Touni, 2009).

Application of organic materials increased plant total and grain yield, protein content, 1000-kernel weight and number of grains in spike (Uyanaz *et al*., 2006) Addition of organic materials enhanced Stover and grain yielded of maiz (Basyouny *et al*., 2003) and accelerate the fertilization process and consequently the quality of manure throughsome treatments on organic materials to be converted in to fertilizer (Anwar *et al*., 20015).

Chemical analysis of rice residual compost

Compost increases the number, diversity and activity of soil microorganisms (Zheng *et al*., 2014). Thus, fertilizer produced from rice straw is more effective than incineration. The hay is incorporated directly into the soil or mixed as compost by the manufacturing process which is considered a dynamic process that includes rapid reactions around the cracking of controlled organic matter aerobic conditions in usable products (Kumar, 2011). Rice straw contains a chemical composition distinctive for the rest of the byproducts of other grains, on average rice straw consists of quinine (10 - 15%) and silica form (45%) silizoat, (9- 12%)and cellulose about (40 - 50%), these ratios on the basis of dry weight (Knauf and Moniruzzaman, 2004). It is difficult to convert these compounds under natural environmental conditions into fertilizers.

On the other hand, it can improve and accelerate the fertilization process and consequently the quality of manure through some treatments on organic materials to be converted into fertilizer (Anwar *et al*., 2015).

Chemical analysis of wheat straw residual compost

Wheat straw is the world's most abundant and least polluted waste among agricultural by-products. Wheat straw is one of the most important by-products (Reddy and Yang, 2005 and Hemdane *et al*., 2016) and is considered the second most abundant stock in the world after rice straw (Amoding, 2007). The main parts of wheat straw are the intercalibrates (68.5%) and leaf sheath (20.3%) contract and fines (4.2%), and grains and debris (1.5%), (Mckean and Jacobs, 1997). Also, wheat straw consists of proteins, carbohydrates, minerals, silica, vitamins and cellulosic components and remains large and precise nutrients concentrations depending on the type of cultivar and the stage of natural growth and climate (Oikonomou, *et al*., 2015). After analyzing of the different wheat straw varieties moisture, fat, crude protein, ash (Nicholson, 1996) and the mineral contents of Na, K, Ca, Mg, Fe, Cu, Zn, and Mn in wheat straw cell wall were identified. Knin as Klason lignin of different types of wheat straw as described by (Wood *et al*., 2014).

Effect of animal by-product

Poultry or chicken manure (CM) is one of the most desirable fertilizer types due to its high content of important elements such as N, P and K. The organic-N in CM is readily available, ranging from 30-50% (Nicholson, 1996). Soil mismanagement and intensive manipulation lead to reducing soil productivity conservation of soil and application of organic matter as (CM) through organic recycling leads to overcome these problems improves the physical, chemical and biological properties of the soil and also the emitted elements can be used in the cultivation of crops (Risse *et al*., 2001).

As chicken manure is an animal by-product, chicken manure is preferred over other animal fertilizers because of its high content of macronutrients (Warman, 1986 and Duncan, 2005). Chestier *et al*., (1986) found that it contains nitrogen levels of 40-60%. The addition of chicken manure to the soil increases the concentration of water-soluble salts in the soil. Plants absorb nutrients in the form of soluble salts, but excessive soil salinity affects the plant nutrient uptake (Stephenson *et al*.,1990).

Soil Microorganisms

The biological component of the soil is responsible for soil humus formation, cycling of nutrient and management of soil tilth and aggregates formation and porosity. (Lynch, *et al*., 1983). Microorganisms in soil consist a part of the biomass and provide soil with nutrients and are generally referred to the microbial biomass. (Insam, 1990).

The application of compost increases the content of organic matter ,nutrients concentration , microbial biomass and improves the soil physical properties (aeration, water holding capacity , porosity ,consistence ,etc.). (Ribereau-Gayon, *et al*,. 1982). Compost is resulted from composting process. The process is an aerobic biological process that uses naturally occurring microorganisms to convert biodegradable organic matter into humus –like product (Bujang and Lopez, 1993). The hygienization of the product by reaching thermophilic temperatures and minimizing mass and volume to be suitable for agricultural uses(Gea, 2005).

It affects nutrient recycling and also affects the physical and chemical properties of soils by –producing extra-cellular sugars and other cellular debris involved in preserving the soil structure through the action of soil particles in the form of cement that stabilizes soil aggregates (Puget *et al*. 1999; and Rice *et al*., 2004).

Factor affecting by-products as organic fertilizer.

Harvesting and continuous cultivation of the land removes nutrients from the soil (Heckman *et al*., 2003), It is necessary to increase crop productivity in organic farming systems. (El-Ghamry *et al*., 2016) Cultivation of high yielding varieties and intensive cultivation leads to nutrient depletion and therefore the soil is almost poor in its contents of nutrients (Wanjari *et al*., 2006). Agricultural products preserve organic carbon, improve soil physical and chemical properties, enhance the biological role of microorganisms and provide nutrients (Hadas *et al*., 2004 and Cayuela *et al*., 2009). It has become necessary to supplement the soil with organic fertilizer to preserve the soil stock of organic matter, in addition to the benefit of organic matter as a source of carbon but considered the source of NPK and improve the structure of the soil, and help to isolate the reaction of the soil, and increase the possibility of water holding and the preparation of suitable conditions to create a suitable biological activity and thus a good environment is created to increase and improve the plant growth yield and quality (Tiessen *et al*., 1994; Reeves 1997, and Hati *et al*., 2007).

CONCLUSION

The use of agricultural organic fertilizers in the soil is an important practice to increase crop yields and also preserve the soil fertility and productivity, the aim of this review article is how to take advantage of the nutrients formed by agricultural by-products (plant and animal) for sustainable agriculture.

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الأسمدة العضوية من المنتجات الثانوية للمزرعة لأجل الزراعة المستدامة

سيوف حامد، أيمن الغمري، كريم فكري و سالي أبو العز

قسم الأراضي، كلية الزراعة، جامعة المنصورة – مصر.

الغرض من هذا البحث هو استبدال مصطلح "النفايات الزراعية" أو "المخلفات الزراعية" بمصطلح "المنتجات الزراعية الثانوية" ، لأن النفايات أو المخلفات كلمة تشير إلى مادة عديمة الفائدة لا يمكن إعادة تدويرها أو إعادة استخدامها مرة أخرى. ومع ذلك ، فإن المنتجات الزراعية الثانوية ليست مهمة فقط في المجال الزراعي، ولكنها مهمة أيضًا لإنتاج الورق والفحم الأسود والوقود وغيرها. وأصبح استخدام المنتجات الزراعية الثانوية مصدر اقتصادي كبير في مجال الزراعة المستدامة من خلال التسميد بجانب استصلاح التربة الصحراوية وتحسين خواص التربة الكيميائية والفيزيائية والبيولوجية والتي تعاني من انخفاض محتوى المواد العضوية بها. علاوة على ذلك، يمكن استخدام منتج ثانوي عضوي للتغطية مما يقلل من فقد الماء عن طريق التبخر. وقد أصبح الاتجاه نحو الزراعة العضوية والاستدامة في الزراعة للحفاظ على خصوبة التربة والسلامة والصحة من أهم المواضيع في هذه الآونة.