EFFICIENCY OF AGRICULUTRAL WASTES AS ORGANIC FERTILIZERS ON SPINACH (*AMARANTUS TRICOLOR* L.) YIELD AND IT IS CHEMICAL CONSTITUENTS

Mona, M. S. Zayed[1]; Esam A.M. Osman[2]; Gehan Helmy [2] and Heba Shokier[2]

1) Microbiology Department, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.
2) Institute of Soil, Water and Environment, Agriculture Research Center, Giza, Egypt.

ABSTRACT

This research deals with using agricultural waste (rice straw) to make fertilizers through bokashi or as compost in a laboratory scale. The first experiment was preparation of anaerobic bokashi is made in closed vessels by using an organic material which was inoculated with the microbial inoculants. Laboratory experiment was conducted in six treatments and incubated for 15 days then dried and analyzed to select the best treatment for a pot experiment. It was carried out in Agricultural Research Center, Giza, Egypt, to study the influence of rice straw as three types incorporating (rice straw, bokashi and compost) with three level of mineral fertilizer (50, 60 and 80% from RD) on spinach yield and some content of nutrients as well as some parameters of soil fertility after harvest in a randomized complete block design. The addition of compost or bokashi plus 80 % of mineral fertilizer gave higher values of fresh and dry matter of spinach crop, as well as most nutrients content of the plant compared with raw rice straw. So, we recommend the addition of bokashi or compost with 80% chemical fertilizer to give the highest spinach yield and its constituents from some macro and micronutrients as well as in soil after harvesting under the same conditions.

Keywords: spinach, rice straw, bokashi, compost, organic manure

INTRODUCTION

Efforts to increase crop productivity must be carried out in synergy with the improvement of soil fertility and productivity through suitable application of fertilizers. Accordingly, increasing the productive capacity of the soil is considered one of the fundamental approaches concerning agricultural researchers around the world. This could be accomplished by using organic fertilizers that intend to store nutrients in the soil for a long time, modify the plant microclimate, and increase the ability of the soil to absorb and exchange soil nutrients **(Aguilar-Rivera and Vázquez, 2018).** Moreover, fertilizers made from agricultural by-products and wastes are an appropriate alternative choice to reduce the negative impacts of agricultural wastes **(Galanakis, 2012; Cañete-Rodríguez *et al*., 2016)**. Technologies of recycling, reuse, and sustainable use of these wastes could reduce contamination and spaces required for waste disposal.

Compost and bokashi are biochemical decomposition processes of organic solid wastes. They are low cost and environmentally friendly waste management options involving solid and liquid by-products, that acts as a soil conditioner and source of nutrients **(Pei-Sheng and Hui-Lian, 2002).**

Bokashi is a fermented organic fertilizer that beneficial to soil and plants produced through the fermentation of different wastes using effective microorganisms, which act as activators to accelerate the composting process **(Ginting, 2019**). Many researchers stated that the bokashi process is relatively better than the traditional composting process, as it is marked by its rapid preparation time (only 2 to 4 weeks) relative to traditional compost (6 months). This process leaves no residual negative effects, such as bad odor and heat **(Xiaohou *et al*., 2008; Yuliana *et al*., 2015)**

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Effective microorganisms are a mixed microorganism culture that consists of lactic acid bacteria, yeast, fermenting fungi, actinomycetes, and photosynthetic bacteria This mixture is widely used as a beneficial microbial inoculum for making bokashi and it helps in increasing crop yields by enhancing soil fertility, preserving the soil productivity, improves its biological properties, and also ameliorating the physical properties of soil structures **(Vetayasuporn, 2006; Wijayanto *et al*., 2016)**

Spinacia oleracea L. is belonging to *the* Amaranthaceae family. It is a favorite leafy vegetable for consumers because it contains a variety of nutrients and has relatively high levels of bioactive compounds like carbohydrates, lipids, protein, minerals, and vitamins A and C (**Parwada *et al.*, 2020**). **Salma *et al.*, (2014)** reported that using organic manure in fertilizing spinach leads to increasing its yield as well as the nutrient levels of N, P and K in soils. **Habibi and Hashimi (2021**) suggested that organic manure can increase crop yield when practiced together with the use of inorganic fertilizers. This study was conducted to investigate the effect of different organic fertilizers on the growth performance and nutrients contents of spinach.

MATERIALS AND METHODS

Production of bokashi: The experiment was conducted in the laboratory at Environmental Research Department, Soils, Water and Environmental Research Institute, Agriculture Research Center. A mixture of microbial inoculants (*Saccharomysis servicea, Lactobacillus lactis* and *Aspergillus oryzae*) plus molasses and water were prepared with a ratio of 1: 1: 1 (on volume basis).

Rice straw was cut into small pieces of approximately 5 cm, and then mixed with animal manure and/or poultry manure with a ratio of 1: 0.5 (w: w). Compost from Al Sharqiya Organic Fertilizer Factory. Molasses was obtained from Al Hawamdia Sugar Company, Giza governorate. While microorganisms were obtained from the Department of Microbiology, Faculty of Agriculture, Ain Shams University and Department of Microbiology, Soils, Water and Environmental Research Institute, Agriculture Research Center. The chemical and physical properties of the used raw materials in this study were determined and recorded in Table (1).

Table 1: Chemical and physical properties of raw materials used

Parameter	Rice straw	Compost	Animal manure	Poultry manure	Molasses
pH (1:10)	5.25	7.47	7.80	7.70	5.00
Ec (ds/m)	4.10	2.36	4.20	3.70	4.90
OM (%)	92.00	35.0	85.00	84.00	-
O.C (%)	53.36	20.30	49.30	48.72	-
C/ N Ratio	118.58	12.68	24.52	23.53	-
Total N (%)	0.45	1.60	2.01	2.070	0.70
Total P (%)	0.33	0.89	1.00	0.90	3.20
Total K (%)	0.15	1.418	1.20	1.30	0.30
ASh (%)	16.00	65.00	15.00	16.00	10.00
Bulk density (kg/m^3)	162	690	700	270	1400

Six different formulations were used to produce the bokashi as follow:

1- Rice straw (1kg) +water
2- Rice straw (1kg) + molasses (200ml) + poultry manure (0.5kg) + water
3- Rice straw (1kg) + molasses (200ml) + animal manure (0.5kg) + water
4- Rice straw (1kg) + molasses (200ml) + microbial inoculants (200ml) + water
5- Rice straw (1kg) + molasses (200ml) + microbial inoculants (200ml) + poultry manure (0.5kg) + water
6- Rice straw (1kg) + molasses (200ml) + microbial inoculants (200ml) + animal manure (0.5kg) +water

The amount of water added was to equalize the water holding capacity of the treatments.

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Each of the previous treatments was mixed and placed in barrel plastic anaerobically for two weeks. Afterwards, the fermented products were dried on a sheet of cloth for one week. Bokashi was digested according to the procedure of **Ryan *et al.*, (1996)**, N was determined using micro Kjeldahl, P was determined by using Spectrophotometer, potassium was determined using flame photometer according to the method of **Black** (**1982**), and organic matter was determined measured according to the procedure of **Klute** (**1986).**

Table 2: Nutrients contents of bokashi as affected by different raw materials

Treatment	N %	P%	K%	OM%	C/N Ratio	PH 1:2.5	Ec (ms/cm)	Ash (%)	Bulk density (kg/m³)
Rice Straw +water	0.60	0.33	1.41	80	81.20	5.25	4.10	17.00	481
Rice Straw+ molasses +poultry manure +water	2.38	0.85	2.62	47.56	11.59	7.81	10.00	0.33	523
Rice Straw + molasses+ animal manure+ water	1.19	0.46	2.62	38.28	18.66	7.80	11.02	0.36	652
Rice Straw + molasses+ microbial inoculants+ water	1.72	0.26	1.31	69.33	23.38	7.59	1.09	0.19	511
Rice Straw + molasses +microbial inoculants + poultry manure+ water	2.67	1.00	2.91	46.40	10.08	7.65	0.464	0.28	551
Rice Straw + molasses + microbial inoculants +animal manure+ water	1.65	0.39	1.98	39.44	13.86	7.63	1.102	0.30	703

Greenhouse experiment

A greenhouse experiment was conducted during the winter season of 2017 in the (SWERI). The experiment was conducted in sandy soil, and the properties of the experimental soil are listed in Table (3).

Table 3: Some chemical and physical parameters of used soils

Parameters	pH 1:2.5	EC (dS/m)	OM	C. Sand	F. Sand	Silt	Clay	Soil texture	Ca+	Mg+	Na^+	K^+	HCO_3	Cl^-	so_4^{--}	N	P	k
		Soil-paste	%						mmol/l							ppm		
values	7.48	0.59	0.22	67.5	22.8	5.0	4.7	Sand	1.602	0.002	3.687	0.618	1.016	3.693	1.20	12.60	3.00	40.02

The experiment was conducted in plastic pots of 25 cm diameter; 17 cm depth: and capacity of 7kg soil in a Randomized Complete Block design with three replicates, to estimate the effect of different organic fertilizers on the growth performance and nutrient constituents of spinach plants in sandy soil. Three different organic fertilizers were used namely compost, bokashi, and chopped raw rice straw 3-5 cm length (supplemented with a mixture of 15ml (*Trichoderma Viride, Trichoderma horizionum and Phanerochaete chrysosporium* 1:1:1). The organic fertilizers were only mixed with different dosages of chemical fertilizers 50, 60, and 80% of the recommended dosage. The full recommended chemical fertilizers dosage was used as a control ((i.e.250, 200 and 50 kg/ fed., which is equal to 1.75, 1.4 and 0.35g /pot from ammonium sulfate (20.6 %N), calcium superphosphate (15.0% P_2O_5), and potassium sulphate (48% K_2O), respectively.

Phosphorus fertilizer was added before planting in a form of calcium superphosphate (15.0% P2O5), while K fertilizer was added in two equal portions, the first dose was after 3 weeks of planting and the second after two weeks from the first one in a form of potassium sulphate (48% K2O). Nitrogen fertilizer was applied in three equal portions, 1/3 of the quantity before sowing, the second and the third ones were added at the same times as K fertilizers with a form of ammonium sulfate (20.6 % N).

Raw rice straw treatments were achieved to the soil 15 days before the sowing of spinach seeds. Also, compost and bokashi treatments were added before sowing directly. The organic fertilizers were added to the soil at the rate of 3 ton/feddan (2g /pot) (Husein et al., 2016).

Ten seeds of spinach were added to each pot on 30 August 2018 and thinned to five plants /pot after one week from planting. Plants were irrigated when needed.

Spinach plants were harvested after 90 days of planting. At the end of the experiment, soil samples were collected from each treatment at 0 to 15 cm from the surface to determine the effect of each treatment on the chemical properties of the soil.

Parameters measurements

Fresh and dry weight of the whole plant were determined according to **FAO (1980).** Plant samples were digested according to the procedure of **Ryan *et al.*, (1996)** to determine N, P, K, Fe, Mn, Zn and Cu. Nitrogen was determined using micro Kjeldahl according to **Jackson (1973)**. While potassium was measured using the flame spectrophotometer method according to **Black (1982)**. Phosphorus was determined by a spectrophotometer. Fe, Mn, Zn, and Cu were determined by using *Atomic* absorption spectroscopy (AAS) as described by **Sultanpour *et al*., (1976).**

Soil analysis:

Soil pH was measured with a glass electrode pH meter (Horiba pH meter M-8L) using a soil water suspension ratio of 1:2.5, as described by **Ryan *et al*., (1996).** EC was measured according to **Scherer *et al.*, (1996**), organic matter was determined as described by **Walkley and Black (1934**), available N was measured according to **Campbell *et al.*, *(*1997),** available phosphorus was determined as described by **Olsen and Sommers (1982)**, available potassium was

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

determined by flame photometry as described by **Ryan *et al*., (1996)** and Cu, Fe, Mn, and Zn were determined by using a*tomic* absorption spectroscopy (AAS) as described by **Sultanpour *et al*., (1976).**

Statistically analysis

The obtained data were statistically analyzed using the MSTAT computer package to calculate the F ratio according to **Gomez, and Gomez (1984**). The Least Significant Range method (L.S.R) was used to differentiate the means at the 0.05 levels as described by **Waller and Duncan (1969**).

RESULTS AND DISCUSSION

Fresh and dry weight nutrients contents of spinach as affected by the application of different organic and mineral fertilizers

Results in Table (4) indicate that the addition of 100% of mineral fertilizer gave a highest significant increase in fresh and dry matter of spinach plant as well as N, P, K % and, Fe, Mn, and Zn (ppm). In most cases, the same trend was observed at the treatment of 80% of recommended dose from mineral fertilizers plus bokashi for such parameters. Whereas the highest significant value of Cu was recorded using compost with 60 or 80 of recommended dose from mineral fertilizers, Also, by 80% of recommended dose from mineral fertilizers plus bokashi or raw rice straw with 50 % from recommended dose.

In contrast, the spinach plant's fresh and dry matter, as well as its N, P, and K percentages, Fe, Mn, and Zn ppm, were significantly increased when 50% mineral fertilizer was applied using rice straw as a raw material. This could be because bokashi has a property of slowly degrading, which may have delayed the release of plant nutrients and minerals into the soil through

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

fermentation (**Parr and Horic, 1995**).

The nutrients released from organic fertilizer support rapid root development (**Baldi and Toselli**, **2013**), which might enhance leaf growth towards the end of plant life. The increase in totally fresh and dry yield may be attributed to the meristematic activity due to producing more tissues and organs since mineral fertilizers play a major role in protein and nucleic acids synthesis and protoplasm formation in addition to induce cell division and initiate meristematic activity for producing more tissues and organs as explained by (**Najm *et al*., 2012**). Also, the high N% of spinach plant with the interaction between the compost and mineral fertilizer compared with bokashi can be attributed to the effect of compost and mineral fertilizer in improving soil physiochemical properties and increasing the availability of macro and micronutrients which led to high vegetative growth and more absorption of nutrients by plants. It's of great importance from the viewpoint of environmental sanitation and the green food production, organic matter contributes to enhancing crop growth and yield directly by supplying nutrients and indirectly by modifying soil physical properties such as stability of porosity and aggregates that can improve the root growth, rhizosphere properties and stimulate plant growth as mentioned by (**Goss *et al*., 2013**).

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Table 4: Fresh and dry weight and nutrients contents of spinach as affected by application of different organic and mineral fertilizers

Treatments	fresh	Dry	N	P	K	Fe	Mn	Zn	Cu
	weight g/pot		%			ppm			
Mineral fertilizer (RD)	54.19	7.433	2.830	0.8733	2.617	36.33	52.20	35.87	4.340
Raw rice straw+ mixture of microbial inoculants +50% Mineral	32.25	3.533	2.430	0.5600	2.310	22.30	11.93	28.53	4.633
Raw rice straw+ mixture of microbial inoculants +60% Mineral	32.72	3.703	2.640	0.6367	2.330	22.30	27.07	34.40	4.310
Raw rice straw+ mixture of microbial inoculants +80% Mineral	38.33	4.290	2.703	0.6400	2.353	34.47	29.20	35.33	4.163
Compost + 50% Mineral	41.44	5.360	2.653	0.4300	2.253	23.07	27.80	22.54	4.223
Compost +60% Mineral	47.28	5.657	2.723	0.6167	2.590	28.40	37.20	31.21	4.823
Compost +80% Mineral	47.12	5.570	2.847	0.6567	2.640	36.87	40.00	37.71	4.860
Bokashi + 50% Mineral	39.56	2.603	2.580	0.6367	2.380	23.03	13.67	30.00	2.800
Bokashi +60% Mineral	45.76	4.660	2.397	0.6600	2.437	30.50	25.70	32.20	4.150
Bokashi +80% Mineral	46.37	7.493	2.787	0.7467	2.460	34.03	26.40	32.00	4.513
LSD	3.497	0.5532	0.2426	0.05425	0.2365	7.172	2.363	2.888	0.3912

N: nitrogen, P: phosphorus, K: potassium

Table 5: Soil nutrients' contents and soil characteristics after spinach harvesting

Treatments	N		P	K	Fe	Mn	Zn	Cu	pH	EC	OM
		ppm							1:2.5	ds/ms	%
Mineral fertilizer (RD)	62.83		12.77	113.6	6.993	2.317	1.957	0.143	7.49	0.603	0.293
Raw rice straw+ mixture of microbial inoculants +50% Mineral	17.91		14.40	169.8	5.517	1.640	1.080	0.140	7.42	0.407	0.333
Raw rice straw+ mixture of microbial inoculants +60% Mineral	27.18		14.11	197.9	6.087	2.737	1.233	0.243	7.32	0.527	0.417
Raw rice straw+ mixture of microbial inoculants +80% Mineral	38.50		12.69	121.0	6.457	3.467	1.440	0.153	7.45	0.410	0.313
Compost + 50% Mineral	40.83		11.29	158.9	8.400	1.567	0.4700	0.260	7.49	0.403	0.177
Compost +60% Mineral	50.17		9.607	138.2	6.303	1.900	1.527	0.160	7.42	0.503	0.237
Compost +80% Mineral	54.36		11.28	206.9	6.173	2.357	1.683	0.177	7.45	0.450	0.197
Bokashi + 50% Mineral	51.10		6.587	137.9	4.860	2.493	1.157	0.077	7.18	0.4167	0.370
Bokashi +60% Mineral	48.53		13.19	149.3	6.233	2.587	1.197	0.153	7.13	0.420	0.337
Bokashi +80% Mineral	80.97		11.66	200.8	8.503	3.293	2.627	0.173	7.32	0.680	0.470
LSD	7.026		0.616	36.27	0.817	0.376	0.282	0.077	0.094	0.077	0.054

N: Nitrogen, P: phosphorus, K: potassium Effect of organic and mineral fertilizers on the chemical composition of soil after spinach harvesting

Data in Table (5) reveal that the addition of 80% from recommended dose of mineral fertilizer with bokashi achieved better values of N, K, Fe, Mn, Zn, EC, and OM of soil after harvest. P and Cu of soil after spinach harvest was improved using 60 % recommended dose with raw rice straw or compost, respectively. Similar trend was observed by 50 % recommended dose with raw rice straw for P only. Full recommended dose of mineral fertilizer gave the highest significant increase in Ec (0.603ms/ds) and pH (7.490) of soil after spinach harvest. On the other hand, in most cases, the lowest values of such parameters were recorded by adding 50% of mineral fertilizer under three treatments of organic manure. Using compost as a valuable alternative to artificial inorganic fertilizers due to their nutrient value, to improve the soil content in OM and consequently the long-term soil fertility and productivity, became widespread around the world. Additionally, they cause a significant saving in fertilizer cost without loss of crop yield (**Sayara *et al.*, 2020).** Mineral fertilizer led to a reduction in humus content and microbial biodiversity in the soil, which may cause inhibition in the growth of crops. The depletion of humus in the soil reduces its ability to store nutrients, and destroys the fundamental principles of agricultural production as well as endangers future food security (**FAO, 2017**).

Although mineral fertilizer may bring about high short-term yield increases, it is, at the same time, harmful to the soil climate, and elements that are fundamental to agricultural production. The use of mineral fertilizer in long term may lead to soil fertility depletion. In this concern, **Myint *et al.*, (2010**) mentioned that the use of mineral fertilizer in long term may lead to soil fertility depletion.

According to **Yuliana *et al.*, (2015,**) addition of organic fertilizers to soil can stimulate the microorganism activities in the soil, which play important roles in the decomposition and mineralization of organic matters in the soil. So, they can increase essential nutrient availability in the soil, applications of organic fertilizers have the capability to increase the carbon contents in the soil, which leads to an increase in soil fertility due to increase in microbial activity. Also,

Vol. (51); Iss. (12); No. (7); Dec. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

the availability of phosphorus increases due to the production of CO_2 and organic acids during decaying of organic components as they have the ability to increase the solubilization rate of phosphate and thereby increase the available mineral P in the soil (**Vargas and Suárez, 2007**).

CONCLUSION

Both of compost and bokashi have many promising properties as they count high content of OM, carbon, macro-and micronutrients. This investigation recommended the addition of bokashi with 80% chemical fertilizer of the recommended dose gave the highest yield of spinach and its constituents from macro and micronutrients in sandy soil, beside the highest macro and micronutrients of soil after harvesting.

REFERENCES

Aguilar-Rivera N., and Vázquez d J D T. (2018). Sustainable Development for Farmers Transforming Agroindustrial Wastes into Profitable Green Products. In W. Leal Filho, R. Noyola-Cherpitel, P. Medellín-Milán, and V. Ruiz Vargas (Eds.), Sustainable Development Research and Practice in Mexico and Selected Latin American Countries (pp. 53-75). Cham: Springer International Publishing.

Baldi E and Toselli M. (2013). Root growth and survivorship in cow manure and compost amended soils. Plant Soil Environ. 59: 221–226.

Black C. A. (1982). Methods of soil analysis.Part 2.Chemical and microbiological properties. Second Edition.Amer. Soc. of Agron. Chem.Ecol.,7:741-752.

Campbell C A, Jame Y W., Jalil A., and Schoenau J. (1997). Use of hot KCl-NH4-N to estimate fertilizer N requirements. Can. J. Soil Sci. 77: 161–166.

Cañete-Rodríguez A. M., Santos D I. M., Jiménez H J E., Ehrenreich A., Liebl W., and García G I. (2016). Gluconic acid: Properties, production methods and applications—An excellent opportunity for agro-industrial by-products and waste bio-valorization. *Process Biochemistry*, *51*(12), 1891-1903. doi:https://doi.org/10.1016/j.procbio.2016.08.028

FAO, (1980). Soil and plant testing as a basis of fertilizer recommendations. FAO Soil Bull., 38/2.

FAO, (2017). The future of food and agriculture trends and challenges. 163 pp.

Galanakis C M. (2012). Recovery of high added-value components from food wastes: Conventional, emerging technologies and commercialized applications. Trends in Food Science and Technology, *26*(2), 68-87. doi:https://doi.org/10.1016/j.tifs.2012.03.003.

Ginting J. (2019). The effect of bokashi rice straw on the increase in production of three purple sweet potato varieties (Ipomoea batatas L.). *IOP* Conference Series: Earth and Environmental Science, *305*(1), 012020. doi:https://doi.org/10.1088/1755-1315/305/1/012020.

Gomez K A. and Gomez A A., (1984). Statistical procedures for agricultural research (2nd Ed.), 457-423.

Goss M J, Tubeileh A. and Goorahoo D. (2013).A Review of the Use of Organic Amendments and the Risk to Human Health. Adv.Agron. 120: 275-379.

Habibi H K., and Hashimi R. (2021). Effects of Organic and Inorganic Fertilizers Applications Levels on Greenhouse Tomato (Solanum lycopersicum) Yield and Soil Quality in Khost Province. Asian Journal of Soil Science and Plant Nutrition,1-10. doi:https://doi.org/10.9734/ajsspn/2021/v7i430117.

Husein M E., Hassan M, S., Abd EL- Latif A L., A Aal M H. and Abd El-Salam F A (2016). Impact of organic and inorganic fertilizers on some soil properties and plant growth. .J. Soil Sci. and Agric. Eng., Mansoura Univ., 7 (3): 267 – 272.

Jackson M L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 498.

Klute A. (1986). Methodsof analysis. part 1, soil physical properties, AsA and SSA,Madison,WI.

Myint A k,Yamakawa T., Kajihara Y., and Zenmyo T. (2010). Application of different organic and mineral fertilizers on the growth yield and nutrient accumulation of rice in a Japanese ordinary paddy field.J. Sci. world 5(2) 47-54.

Najm AA., Hadi M R H., Fazell F., Derzi M T. and Rahi A. (2012). Effect of integrated management of nitrogen fertilizer and cattle manure on the leaf chlorophyll, yield and tuber glycoakaloids of agria potato. Comm. *Soil Sci. Plant Anal*., 43 (6), 912-923.

Olsen S R. and Sommers L E. (1982). Phosphorus. pp. 403-430. In: A. L. Page, et al. (eds.) Methods of soil analysis: Part 2. Chemical and microbiological properties.Agron.Mongr. 9. 2nd ed. ASA and SSSA, Madison, WI.

Parwada C., Chigiya V., Ngezimana W., and Chipomho J. (2020). Growth and Performance of Baby Spinach (Spinacia oleraceaL.) Grown under Different Organic Fertilizers. International Journal of Agronomy, 2020, 8843906. doi:https://doi.org/10.1155/2020/8843906.

Parr J F and horic S B.(1995).Transition from conventional agriculture to nature farming systems: The role of microbial inoculates and organic fertilizers.In Parr.J.F and S. B horic (Eds). Proceeding of the 4th International Conference on Kyusei nature farming.19-21June.Paris, Farance,pp25.

Pei-Sheng Y. and Hui-Lian X. (2002). Influence of EM Bokashi on Nodulation, Physiological Characters and Yield of Peanut in Nature Farming Fields. Journal of Sustainable Agriculture, *19*(4), 105-112. doi:10.1300/J064v19n04_10.

Ryan J S., Garabet K H., and Rashid A. (1996). A soil and plant Analysis Manual Adapted for the west Asia and North Africa Region. ICARDA, Aleppo, Syria. 140pp.

Salma S., Khan M., and Saleem J. (2014). Effect of organic and inorganic fertilizers co-applied with effective microorganism (EM) on growth and yield of spinach (Spinachia olerace). Sarhad Journal of Agriculture, 30(4), 411-418.

Sayara T., Salimia R B., Hawamde F and Sánchez A. (2020). Recycling of Organic Wastes through Composting: Process Performance and Compost Application in Agriculture. Agronomy, 10, 1838.

Scherer T F., Seelig B and Franzen D. (1996). Soil water and plant characteristics important to irrigation. http://www.ag.ndsu.edu/pubs/aeng/irrigate/eb66whtml.

Sultanpour P N., khan A and Lindsay W L. (1976). Factros affecting *DTPA extractable* Zn, Fe, Mn, and Cu from soils commuen.soil.Sci.Plt*A*nl.7:797-821.

Vargas G M C and Suárez F. (2007). Effect of the application of compost on the properties biological soil.In: Moreno C.J.and Moral H.R.(eds.).Composting.Ed. Mundi-press.Madrid. p.329-350.

Vetayasuporn S. (2006). Effects of biological and chemical fertiliser on growth and yield of glutinous corn production. Journal of Agronomy.

Walkley A J and I A Black. (1934). Estimation of soil organic carbon by the chromic acid titration method. Soil Sci. 37: 29-38.

Waller R A and Duncan C B.(1969). A bay rule for symmetric multiple comparison problem Amer. State Assoc. Jour. December: 1485-1503.

Wijayanto T., Zulfikar T M., Sarman A., and Zamrun M. (2016). Influence of bokashi fertilizers on soil chemical properties, soybean (Glycine max (L.) Merrill) yield components and production. WSEAS Transactions on Biology and Biomedicine, 13, 134-141.

Xiaohou S., Min T., Ping J and Weiling C. (2008). Effect of EM Bokashi application on control of secondary soil salinization. Water Science and Engineering, 1(4), 99-106. doi:https://doi.org/10.3882/j.issn.1674-2370.2008.04.011.

Yuliana A., Sumarni T and Islami T. (2015). Application of bokashi and sunn hemp (Crotalaria juncea L.) to improve inorganic fertilizer efficiency on maize (Zea mays L.). *Journal of Degraded and Mining Lands Management*, *3*, 433-438. doi:https://doi.org/10.15243/jdmlm.2015.031.433.

فاعلية استخدام المخلفات الزراعية كسماد عضوي على نمو نبات السبانخ ومكوناته الكيميائية

منى محمد سعيد زايد [١]- عصام الدين عبد العزيز محمد عثمان[٢]- جيهان حلمى عبد العزيز[٢]- هبة شقير[٢]
١) قسم الميكربيولوجيا، كلية الزراعة، جامعة عين شمس، القاهرة،م صر ٢) معهد التربة والمياه والبيئة ، مركز البحوث الزراعية، الجيزة ، مصر.

المستخلص

يعتمد تجهيز البوكاشي على التخمير بدلاً من التعفن ويكون بمعزل عن الهواء في أوعية محكمة الغلق. يصنع البوكاشي من مواد عضوية (قش الأرز الخام) الملقح بميكروبات وقد أجريت هذه التجربة ب ٦ معاملات وثلاث مكررات على النحو التالي:

١-قش الأرز + الماء، ٢- قش الأرز + المولاس+ سماد الدواجن + الماء، ٣- قش الأرز + المولاس + السماد الحيواني + الماء، ٤- قش الأرز + المولاس + اللقاح + الماء، ٥- قش الأرز + المولاس + اللقاح + سماد الدواجن + الماء، ٦- قش الأرز + المولاس + اللقاح + السماد الحيواني + الماء. بعد ١٥ يوم من تلقيح كل المعاملات تم فردها على قطعة من القماش لمدة أسبوع. ثم بعد ذلك اختيار المعاملة قش الأرز + اللقاح + المولاس + الماء + سماد الدواجن لاستخدامها في تجربة أصص زراعية بقسم خصوبة الأراضي وتغذية النبات، معهد بحوث الأراضي والمياه والبيئة، مركز البحوث الزراعية، جيزة، مصر خلال الموسم الزراعي ٢٠١٧ وذلك لدراسة تأثير قش الأرز المخلوط بالتربة بثلاثة صور (قش الأرز الخام، البوكاشي، الكمبوست) بالإضافة إلى ٣ مستويات من السماد المعدني (٥٠ و ٦٠ و ٨٠% من التوصية السمادية) ومقارنتها ب ١٠٠% من التوصية السمادية لمحصول السبانخ وأثر ذلك على محصول السبانخ الطازج والجاف ومحتواه من بعض العناصر الكبرى والصغرى. كما أجريت أيضاً بعض التحليلات الخاصة بالتربة تحت الدراسة.

وقد أعطت إضافة الكومبوست أو بوكاشي بالإضافة إلى ٨٠٪ من السماد المعدني قيمًا افضل لمحصول السبانخ الجاف والطازج، بالإضافة إلى معظم العناصر الغذائية للنبات مقارنة بقش الأرز الخام. لذلك أوصينا بإضافة البوكاشي أو السماد العضوي الى ٨٠٪ من التوصية السمادية المعدنية من اجل الوصول الى محصول أعلى من السبانخ ومكوناته من بعض المغذيات الدقيقة والصغرى و مثيلاتها فى التربة بعد الحصاد تحت نفس الظروف.

الكلمات المفتاحية: السبانخ، قش الأرز، البوكاشي، كمبوست، السماد العضوي.