J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 10 (5): 285 - 290, 2019

Mineral and Organic Additives Combination as a Modern Technique for Maximizing Crop Productivity in Organic Farming Systems

El-Sayed, Kh. El- M.; A. A. Mosa and A. M. El-Ghamry
Soils Department, Faculty of Agriculture, Mansoura University, 35516 Mansoura, Egypt

ABSTRACT

Recently ecological intensification is introduced as a modern approach for enhancing the productivity of organic farming systems to maximize their economic returns. For this purpose, a pot experiment was conducted during the autumn season of 2018 at the Experimental and Agricultural Research Center, Mansoura University in order to evaluate the efficiency and applicability potential of engineered organic blocks derived from mineral and organic additive combination for improving cucumber productivity under sandy soil conditions. In a split-split plot design with three replicates, 36 treatments were arranged to represent three combinations of compost application (i.e. 100% compost, 75% compost + 25% rice straw and 50% compost + 50% rice straw), organic additives (control, seaweed (SW), chicken manure (CM), and seaweed + chicken manure combination) and three mineral additives (control, natural mineral ores (rock phosphate and feldspar) and a partial dose of NPK fertilizers. The obtained results cleared that 100% compost, (SW) + (CM) combination and the partial mineral NPK application were the superior treatments for increasing marketable yield productivity (Mg Fed^{-1}), quality of fruits shape (weight, length and diameter) as well as nitrogen (N), phosphorus (P) and potassium (K) concentrations in fruits. The mutual interaction among mineral and organic constitutions of the engineered blocks introduced mineral ores application as an efficient treatment with a high capability to improve the uptake of plant nutrients (N and P in particular). It is recommended, therefore, using the combination of organic additives (e.g. CM, SW) as well as mineral additives (e.g. rock phosphate, feldspar or partial dose of NPK) to achieve the ecological intensification in organic farming systems.

INTRODUCTION

Egypt is facing a turbulent increase in its growth population, as it has become nearly 100 million habitats or more. This imbalance between fast growth population and limited agricultural resources has resulted in a shortage in food, feed and fiber supplies. Consequently, it is necessarily to expand in the projects of sandy soils reclamation to fill the gap of food supplies to achieve the food security for new generations.

There is a debate between researchers regarding the most efficient approach for managing the low nutrient supply potentials of sandy soils. A group of scientists favor the absolute organic farming system (AOFS) as traditional technique for improving the fertility and water holding capacity of sandy soils. On contrary, others scientists favor the conventional farming system CFS (chemical fertilization) as the most efficient approach for sandy soil reclamation given the low productivity of organic farming. Thus, there is a critical need to capitalize modern approaches for modern soil reclamation to maximize the economic returns in an ecological manner. This modern approach should combine both properties of AOFS sustainability and the high productivity of CFS.

According to Selim and Mosa, (2012), the traditional method of organic fertilizers applications depends on incorporating organic fertilizers (e.g. compost) into the plow layer of soil. However, this traditional technique needs huge amounts of compost to achieve a pronounced influences; this is beside the high cost of labor.

Cucumber (*Cucumis sativus* L.) is an ancient vegetable and belongs to the Cucurbitaceae family (Eifeyidi and Remison, 2010). Cucumber fruits are rich source of both vitamins and minerals. It is ranked as the third economic vegetable crop in Egypt after tomato and cabbage; however, it ranks the second in Europe after tomato (El-Sayed *et al.*, 2014). However, cucumber production requires moderate to high nutrient rates to achieve high cumulative yields (Eifeyidi and Remison, 2010). There is an urgent need, therefore, to apply the sufficient nutrients requirements necessarily to sustain its growth and yield.

Compost is one of the most common sources of manures application. The addition of compost has a positive influences on all soil properties such as soil structure, water holding capacity, porosity, compaction strength, availability of elements in soil, O.M. content of the soil, hence enhances plant growth parameters, yield and crop quality (Fahmy, 2012). Additionally, chicken manure is rather an important source in organic farming systems. According to Mohammed *et al.*, (2010), chicken manure is a useful organic fertilizer as it contains about 3.5% N, 1.5-3.5% P, 1.5-3.0% k and many microelements. On the other hand, seaweeds (marine algae) not only contain N, P and K but also contain substantial molecules with ability to improve soil aggregation and phytohormones with various metabolic activities like organic and amino acids (Ahmed and Shalaby, 2012).

Feldspar is a three dimensional mineral structure with a network of SiO2 tetrahedral in the two groups. Potassium occurs as a major component within the feldspars and felspathoid mineral groups, thereby it is considered as an important source of potassium fertilization (Manning, 2010). Also, rock phosphate is one of the most important sources of phosphorus. Through composting technology, the unavailable P is expected to convert into available forms for plants due to the acidic environment prevailing during composting technology, thereby enhanced the nutrient content of compost (Meena and Biswas, 2015).

The main aim of this study, therefore, is to explore the applicability of organic and mineral additives incorporation alongside with compost in order to maximize the crop productivity of cucumber grown under sandy soil conditions

MATERIALS AND METHODS

Design of the experiment, and its layout.

A pot experiment was carried out during the autumn season of 2018 at Experimental and Agricultural Research Center, Mansoura University, Dakahlia Governorate, Egypt aiming to evaluate the applicability of engineered organic blocks as a substitution of the ordinary compost in organic farming systems. Cucumber (*Cucumis* *sativus,* L. cv. 196) was selected to serve as a tested plant based on its economic revenue. In a split-split plot design with three replicates, treatments were arranged to represent three compost combinations, organic additives and mineral additives. Main plots were assigned to the compost combination (i.e. 100% compost, 75% compost + 25% rice straw (RS) and 50% compost + 50% rice straw). In subplots, each combination was involved (control, seaweed, chicken manure and seaweed, chicken manure combination). In sub-sub plots, mineral additives were involved (control, natural mineral ores and partial dose of NPK fertilizers). Table (1) clarified layout of the experiment.

Table 1. Experimental Layout for Treatments.

Compost combination	Organic additives	Mineral additives		
100% compost	control	control	RP+FS	NPK
	SW	control	RP+ FS	NPK
	CM	control	RP+ FS	NPK
	SW+CM	control	RP+ FS	NPK
75% compost + 25% RS	control	control	RP+ FS	NPK
	SW	control	RP+ FS	NPK
	CM	control	RP+ FS	NPK
	SW+CM	control	RP+ FS	NPK
50% compost + 50% RS	control	control	RP+ FS	NPK
	SW	control	RP+ FS	NPK
	CM	control	RP+ FS	NPK
	SW+CM	control	RP+ FS	NPK

(RS) rice straw. (RP) rock phosphate. (FS) Feldspar

Materials

Mature compost (50% rice straw, 25% farmyard manure and 25% musty compost) was purchased from a private company (El-Wedian) located at Giza Governorate. Rice straw obtained from Mansoura District, Dakahlia Governorate, was cut into small pieces (0.5-2.5 cm length), air dried, and preserved for the experiment.

Seaweed (SW) as Organic additives was a kindly endued from National Institute of Oceanography and Fisheries in Hurghada (NIOF), Egypt (Table 2) . Chicken manure(CM) was obtained from Experimental and Agricultural Research Center, Mansoura University, Dakahlia Governorate, Egypt.

The mineral NPK fertilizers were urea (46% N), mono-oxide phosphorus (21.8% P) and potassium sulfate (41.5% K). In addition, rock phosphate was purchased from the Fertilizers and Chemical Company at Abu-Zaabal District, Qalubia Governorate to serve as a source of phosphorus. Feldspar was obtained from Sinai Manganese Company to represent the potassium source. In order to improve the efficiency and applicability of mineral additives incorporated with organic additives, nitrogen fixing as well as potassium and phosphorus dissolving bacteria were inoculated for nitrogen fixation and accelerate the dissolution phosphorus and potassium from phosphate rock and feldspar. These bacterial inoculations have complemented kindly from the Department of Soil, Water and Environmental Research Institute, Giza.

The chemical composition of the used organic additives and the natural mineral ores additives is illustrated in Table 2.

Table 2. Chemical composition of the organic additives and natural mineral ore additives.

Chemical composition		Moisture content (%)	pH (1:10)	EC (1:10), dSm^{-1}	OM (%)	Organic carbon (%)	Total nitrogen (%)	C/N ratio	Total Phosphorus (%)	Total potassium (%)
Organic substrates	Rice straw	8.37	6.38	2.53	82.06	47.60	0.62	76.77	0.28	0.49
	Compost	27.4	7.49	2.37	33.77	19.59	1.51	12.97	0.57	0.71
	Sea weed	9.5	7.63	2.11	57.87	33.57	0.86	39	0.67	3.21
	Chicken manure	23.51	7.59	5.17	40.87	23.71	2.48	9.56	0.61	2.01
natural mineral ore	Rock phosphate	1.3	8.19 (1:2.5)	3.41 (1:2.5)	N.D.	N.D.	0.04	------	11.36	0.59
	Feldspar	0.87	9.72 (1:2.5)	7.74 (1:2.5)	N.D.	N.D.	0.03	------	0.09	12.01

N.D. means not detected

Chemical analyses of compost combinations, types of organic additives and mineral additives were carried out according to the standard methods: (Richards, 1954), (Richards, 1954), (Walkley and Black, 1954) (Peterburgski, 1968).

Engineered organic blocks.

Prior to block preparation, SW and CM were applied to investigated compost at rates of 2.0, 20.0 g/block, respectively. RP and FS were applied at rates of 16.5 and 17.5 g/block, respectively. Urea, mono-oxide phosphorus and potassium sulfate were applied at 3.19, 2.14 and 5.2 g per block, respectively. All mixtures were compressed to 2.5 bar $inch^{-1}$ using a mechanical compressor at moisture content of 45% for making compost blocks (Fig. 1). The compressed blocks of compost combination were air-dried until the weight constant (less than 5% difference between successive two weights).

The pot experiment.

Outdoor pot experiment was undertaken at Experimental and Agricultural Research Center, Mansoura University, Dakahlia Governorate, Egypt. Before cucumber seeding, 108 polyethylene pots of 25 cm diameter and 25 cm length were used. Each pot was filled with 15.200 Kg of washed sand. Engineered organic blocks were instilled inside sandy soil in pots. Irrigation was scheduled according to the plant growth stage, and soil moisture content. At harvesting stage (55-60 days from sowing), fruit yield during the harvesting stage was recorded. Besides, fruit quality parameters (fresh weight of one fruit, fruit height and diameter) were also measured. In addition, representative fruit samples were air and oven dried at 70 ±5 °C until weight constant. 0.2 g of subsamples were acid-digested with a 1:1 mixture of sulfuric (H_2SO_4) and per-chloric ($HClO_4$) acids according to Peterburgski, (1968) to determine total N, P and K concentrations. Representative compost samples (0.2 g) were collected for carrying out compost analyses at harvesting stage. Subsampling was carried out by hand after quartering homogenous soil sample until obtaining desired amount for analysis (ISO 11464). Blank corrections were performed without the analytic to ensure reliability of data. Besides, calibration curves were performed using stock standards to optimize quality control standards.

Fig. 1. Photo for the used mechanical compressor.

Statistical analysis

Statistical analysis of all experimental data were done using the statistical software package CoStat, (2017) Version 6.450. All comparisons were spilt-split plot analysis of variance (ANOVA).

RESULTS AND DISCUSSION

According to presented in Table 3. application of compost (100%) gave the highest total marketable yield with increments of about 35.4 and 59.2% higher than those of 75% compost + 25% RS and 50% compost + 50% RS, respectively. This finding highlighted the superiority of compost application as compared to raw RS and the urgent need to incorporate additional organo-mineral supplementation alongside with RS to achieve the ecological intensification in organic farming systems. Although compost application is often the most efficient organic amendment in organic farming systems, its application is also associated with several drawbacks. According to Wang *et al.* (2004), compost application may cause several disadvantages including (1) raising in soil pH, (2) high soluble salts content, (3) nitrogen immobilization during the initial application phase, especially if it did not reach the full maturity stage, (4) release of several phytotoxic compounds, phytoxicity associated with high concentrations of NH_3 and the NH_4 – N, potentially toxic elements (e.g. Cu and Zn) phenolic compounds and low molecular organic acids (e.g. butyric, propionic and acetic acids).

Poultry manure application recorded a stimulating effect to the growth performance and total productivity of the obtained yield. As cleared in Table 3. CM application enhanced the produced yield by about 33.9% compared to the control treatment. This could be attributed to the beneficial effect of poultry manure on soil physical properties (e.g. soil porosity, soil heat and water supply potential of soil (Ojeniyi, 2008). Furthermore, several reports have presented the beneficial effect of CM on increasing soil organic matter content, improving soil microbial populations, control plant pests and nematodes (Malik and Bradford, 2007).

Table 3. Effect of compost, organic and mineral additives application treatments on cucumber fruit parameters.

Treatment	Fruit weight (cm)	Fruit length (cm)	Fruit diameter (cm)	Total yield Mg Fed^{-1}
		Effect of Compost		
50% C + 50% RS	56.528	9.953	2.075	2.61
75% C + 25% RS	58.199	10.537	2.190	4.129
100% C	59.495	11.125	2.324	6.393
Significant	**	**	**	**
LSD 5%	0.220	0.047	0.015	0.183
		Effect of Organic		
control	50.113	8.929	2.018	3.299
SW	52.520	10.377	2.163	3.778
CM	63.129	11.053	2.259	4.991
SW+CM	65.154	11.518	2.316	5.478
Significant	**	**	**	**
LSD 5%	0.193	0.041	0.012	0.253
		Effect of Mineral		
control	54.609	9.655	2.103	3.64
RP+FS	57.085	10.793	2.221	4.465
NPK min	62.528	11.166	2.265	5.026
Significant	**	**	**	**
LSD 5%	0.160	0.027	0.004	0.031

Seaweed incorporation with CM led to enhance the total marketable yield of cucumber fruits compared to the sole application of CM (5.478 and 4.991 Mg Fed^{-1}). Seaweed extracts could have several beneficial effects on growth stimulation, seed germination, growth performance, root development as well as yield and quality of most vegetables, (Vasantharaja *et al.*, 2019).

Regarding the effect of mineral additives application, it is clearly noticeable that mineral NPK application recorded the highest application treatment with an increment of about 11.2% comparing with mineral ores application. Given the short-life period of cucumber until completing the harvesting stage (approximately 75 days), the mineral fertilizer dose gave the plant its full requirements necessarily to obtain the high yield. However, not only the quantitative yield parameters but also its qualitative indices are underlying the economic returns of cucumber fruit yield.

In modern agricultural systems, the target is not only to maximize the quantity of the obtained yield, but also to raise its qualitative parameters including its post-harvest shelf life. According to a recent study, the extract of *Sargassum swartzii* (brown seaweed) (SSE) and *Kappaphycus alvarezii* (red seaweed) showed a stimulating effect on the shelf life of *Vigna unguiculata* (Vasantharaja *et al.*, 2019). In addition, the fruit's shape (i.e. length and diameter) is an important criterion to justify the quality of fruits. According to the obtained data in Table. 3, the quality parameters of cucumber fruits (fruit's weight, length and diameter) followed the same aforementioned trend as the full application of compost, CM + SW and mineral NPK fertilizers were the superior treatment for improving these quality indices.

Regarding the interaction effect between treatments, as shown in Table 4, it is cleared that the combined treatment of mineral NPK application alongside with 100% compost and CM + SW was the superior treatment for obtaining the highest total marketable yield and quality of fruits shape. The mutual interactions among these constitutions might improve water and nutrient supply potentials of soil to sustain the plant growth until reaching harvesting stage.

Table 4. The interaction effect among compost, organic and mineral additives application treatments on cucumber fruit parameters.

Treatments			Fruit weight	Fruit length	Fruit diameter	Total yield
50% C + 50% RS	control	control	44.600	7.007	1.777	0.800
		RP+FS	47.180	8.337	1.905	1.520
		NPK min	54.233	8.757	1.957	2.000
	SW	control	47.300	9.007	1.977	1.400
		RP+FS	49.880	10.337	2.105	2.120
		NPK min	58.100	10.757	2.157	2.600
	CM	control	59.540	9.847	2.067	2.384
		RP+FS	62.420	10.897	2.177	3.416
		NPK min	63.500	11.107	2.207	3.800
	SW+CM	control	61.700	10.547	2.127	2.840
		RP+FS	64.100	11.317	2.207	3.920
		NPK min	65.780	11.527	2.237	4.520
75% C + 25% RS	control	control	45.554	8.057	1.907	2.460
		RP+FS	48.410	9.457	2.037	3.060
		NPK min	58.100	9.947	2.097	3.480
	SW	control	47.954	9.357	2.057	2.960
		RP+FS	50.810	10.757	2.187	3.560
		NPK min	60.500	11.247	2.247	3.980
	CM	control	61.340	10.337	2.187	3.908
		RP+FS	64.100	11.317	2.287	4.976
		NPK min	65.300	11.527	2.327	5.540
	SW+CM	control	63.500	10.967	2.247	4.100
		RP+FS	65.120	11.667	2.337	5.228
		NPK min	67.700	11.807	2.367	6.296
100% C	control	control	47.180	8.607	2.077	4.880
		RP+FS	49.700	10.147	2.227	5.420
		NPK min	60.020	10.707	2.247	5.960
	SW	control	48.980	9.707	2.167	5.180
		RP+FS	51.500	11.247	2.317	5.720
		NPK min	61.820	11.807	2.337	6.260
	CM	control	62.720	10.897	2.287	6.176
		RP+FS	64.700	11.877	2.407	7.064
		NPK min	66.740	12.227	2.447	7.592
	SW+CM	control	64.940	11.527	2.357	6.596
		RP+FS	67.100	12.167	2.467	7.580
		NPK min	68.540	12.583	2.553	8.287
	Significant		**	**	**	**
	LSD 5%		0.599	0.100	0.016	0.116

Data presented in Table 5. illustrated that full application of compost (100%) exhibited the highest N content with increments of about 7.43 and 17.39% higher than those obtained by 75%C +25% RS and 50%C + 50RS, respectively. Unlike most feedstock materials (e.g. wheat straw), rice straw is rapidly decomposed with a noticeable reduction in C/N ratio given the fast increase of composting temperature during the initial phases (Wang *et al.*, 2016). It is worthy noting that the yield reduction of 75%C +25% RS could be considered as a cost-effective treatment for recycling/disposing the huge amounts of rice straw as fresh rice straw could reach its maturity stage during the initial phases of mixing with compost. This finding is matched with those obtained by (El-Ghamry, 2016).

Regarding the effect of organic additives, it is cleared that the supplemental application of seaweed enhanced performance of CM compared to the sole application of CM. Additionally, N concentration in this superior treatment was about twofold higher than the control (without organic additives). Although N concentration in seaweed was significantly lower than that in CM (0.84% *vs.* %3.5), the motivating effect of seaweed on nitrogen uptake comes from its enhancement effect to the plant tolerance against biotic and abiotic stresses as well as improving plant growth architecture, thereby improving the plant capacity toward nitrogen uptake (Zhang and Schmidt, 2000).

Other reports suggested that this beneficial effect is mainly revealed to the presence of plant nutrients (micro-nutrients in particular), readily available amino acids, vitamins, pigments, and complex polysaccharides that contribute to improve the growth of plant (Calvo *et al.*, 2014).

Table 5. Effect of compost, organic and mineral additives application treatments on N, P and K concentrations in fruits.

Treatments	% N	% P	% K
Effect of Compost			
50% C + 50% RS	1.501	0.139	1.503
75% C + 25% RS	1.682	0.159	1.694
100% C	1.817	0.177	1.886
Significant	**	**	**
LSD 5%	0.069	0.002	0.010
Effect of Organic			
control	1.107	0.093	1.025
SW	1.256	0.126	1.267
CM	2.039	0.200	2.140
SW+CM	2.203	0.209	2.274
Significant	**	**	**
LSD 5%	0.052	0.001	0.016
Effect of Mineral			
control	1.372	0.132	1.376
RP+FS	1.756	0.169	1.820
NPK min	1.872	0.174	1.887
Significant	**	**	**
LSD 5%	0.041	0.001	0.014

On the other hand, nitrogen concentration in cucumber fruits was comparable between plants amended with either natural mineral ores of NPK fertilizers (1.756 vs. 1.872%, respectively). This concentration, however, was significantly lower in the un-amended treatment (1.372%). Rock phosphate and feldspar provides a slow released supply for P and K requirements until reaching the flowering stage of cucumber as compared with the fast released supply of mineral NPK. Accordingly, their application into organic fertilizers might enhance plant growth and root development/architecture toward the uptake of N.

Regarding the effect of organic amendments application on phosphorus concentration in fruits, it is cleared that 100% compost application ranked as the first treatment with an increment of about 10.17% higher than 75% compost + 25% RS. The higher phosphorus content in compost (0.57 vs 0.28) Table 2. And its higher readiness for plant uptake compared to raw rice straw might encourage phosphorus absorption and translocation into fruits. The beneficial effect of seaweeds application on phosphorus uptake by plants was recently studied (El-Alsayed *et al.*, 2018). According to this study, seaweed extract is able to increase the electronegativity of soil surfaces, thereby reducing its binding capacity by soil particles. Additionally, soil application of seaweed not only increased phosphate mobility but also enhanced its release into soil solution, thereby its uptake by plant roots.

These results suggest that SW extracts applications increased the net negative surface charge also reduces the soil phosphate adsorption capacity. Data of this study showed that seaweed not only decreased phosphate retention by the soil but also increased phosphate release into the soil solution. The same trend of mineral additive application was the same with phosphorus concentration in fruits as the mineral phosphate application enhanced phosphorus uptake by plants given the higher solubility of its phosphorus content comported to rock phosphate.

The compost application treatment (100%) gave the highest K concentration in fruits compared to other treatments. Potassium concentration in compost was by far greater than that in raw rice straw. It is well known that potassium is not existed organically in plant tissues

(Marschner, 2011). Therefore, it is readily available for plant uptake following soil compost application. Seaweed supplementation into organic additions raised K concentration in fruits as compared to the sole CM application (2.274 vs. 2.140%). Presumably, due to the motivation of the plant physiological, mechanism responsible for potassium uptake by plants. Potassium uptake from soil into plant cells is mediated by low and high affinity transport systems taking advantage of the electrical gradient and / or the proton motive force established by H+- ATPases (Dreyer and Uozumi, 2011). The stimulating effect of SW to hormone signalling in plant responses may be the main reason for increasing plant capacity toward K uptake.

Potassium concentration in cucumber fruits amended with either mineral NPK or natural ores was comparable with as slight increase with those amended with mineral NPK (1.887 and 1.820%, respectively). In Egypt, there are numerous reports suggest the high efficacy of feldspar application as a natural ore application (Manning, 2010). The slow-release of potassium from feldspar might introduce a rich source of potassium with a long-time release during the plant physiological life.

The interaction effect between treatments is presented in Table 6. Surprisingly, it could be noted that mineral ores supplementation alongside with 100% compost and CM + SW recorded the highest concentrations of N and P. Accordingly; it is strongly recommended to incorporate natural ores supplementation in organic additives to achieve the ecological intensification in organic farming systems. The synergistic effect of the chemical constitutions of the combined organic form might lead to improve the mutual uptake of N and P. For example, N-fixing bacteria, which is the main sources for nitrogen supplementation might cause an acidifying effect in the root zone, thereby improved phosphorus uptake conditions

Table 6. The interaction effect among compost, organic and mineral additives application treatments on N, P and K concentrations in fruits.

Treatments			% N	% P	% K
50% C + 50% RS	control	control	0.787	0.053	0.703
		RP+FS	0.997	0.070	0.910
		NPK min	1.074	0.077	0.987
	SW	control	0.987	0.103	1.003
		RP+FS	1.197	0.120	1.210
		NPK min	1.274	0.127	1.287
	CM	control	1.596	0.157	1.627
		RP+FS	2.002	0.191	2.027
		NPK min	2.090	0.197	2.123
	SW+CM	control	1.656	0.163	1.693
		RP+FS	2.143	0.202	2.200
		NPK min	2.206	0.209	2.267
75% C + 25% RS	control	control	0.908	0.078	0.823
		RP+FS	1.183	0.101	1.117
		NPK min	1.260	0.110	1.177
	SW	control	1.058	0.108	1.063
		RP+FS	1.333	0.131	1.357
		NPK min	1.410	0.140	1.417
	CM	control	1.735	0.168	1.763
		RP+FS	2.265	0.214	2.320
		NPK min	2.342	0.222	2.393
	SW+CM	control	1.795	0.175	1.883
		RP+FS	2.410	0.228	2.473
		NPK min	2.481	0.234	2.547
100% C	control	control	1.018	0.095	0.943
		RP+FS	1.366	0.126	1.310
		NPK min	1.451	0.130	1.357
	SW	control	1.118	0.115	1.133
		RP+FS	1.466	0.146	1.500
		NPK min	1.551	0.150	1.547
	CM	control	1.866	0.181	1.903
		RP+FS	1.968	0.241	2.607
		NPK min	2.648	0.245	2.683
	SW+CM	control	1.939	0.185	1.973
		RP+FS	2.738	0.256	2.810
		NPK min	2.679	0.251	2.863
Significant			**	**	**
LSD 5%			0.004	0.052	0.154

Meanwhile, the mineral NPK application treatment alongside with 100% compost and CM + SW gave the highest potassium concentration in fruits. This could be attributed to the luxury consumption of potassium from several mineral and organic forms.

CONCLUSION

Based on the obtained results of this experiment, it could be concluded that incorporating some organic and mineral additives to alongside with compost application can maximize crop productivity in newly reclaimed sandy soils. This research indicated the urgent need to incorporate additional organo-mineral supplementation alongside with RS to achieve the ecological intensification in organic farming systems

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خلط الإضافات العضوية والمعدنية كتقنية حديثة لتعظيم انتاجية المحصول في نظم الزراعة العضوية

خالد السيد المتولى ، احمد علي موسي وايمن محمد الغمري

قسم الأراضى- كلية الزراعة – جامعه المنصورة

مصطلح التكثيف البيئي تم تقديمه في الآونة الأخيرة كمنهج حديث لزيادة انتاجية نظم الزراعة العضوية لزيادة عوائدها الإقتصادية. لهذا الغرض, تم اجراء تجربة أوعية خلال خريف عام ٢٠١٨ بمركز التجارب والبحوث الزراعية, جامعة المنصورة بهدف تقييم الإمكانية التطبيقية لمكعبات عضوية مصنعة كتقنية حديثة لاضافة الأسمدة العضوية. في نظام القطع المنشقة مرتين بثلاث مكررات, تم توزيع ٣٦ معاملة لتمثل ثلاثة خلطات من اضافة الكبوست (١٠٠ كمبوست, ٧٥% كمبوست + ٢٥% قش أرز خام و ٥٠% كمبوست + ٥٠% قش أرز خام), أربعة اضافات عضوية (بدون اضافة, طحالب بحرية, سماد الدواجن, ومخلوط من سماد الدواجن والطحالب البحرية) بالإضافة إلي ثلاث معاملات للإضافات العضوية (بدون, مواد خام طبيعية (صخر الفوسفات والفلسبار) وجرعة جزئية من السماد المعدني NPK).أظهرت النتائج المتحصل عليها أن اضافة الكمبوست بنسبة ١٠٠%, اضافة الطحالب البحرية مع سماد الدواجن و الجرعة الجزئية من السماد المعدني كانت هي المعاملات الأكفأ لزيادة انتاجية المحصول التسويقية (طن/الفدان) و جودة مظهر الثمار (الوزن, الطول والقطر) بالإضافة إلي تركيزات عناصر النيتروجين والفسفور والبوتاسيوم في الثمار. التفاعلات المشتركة بين المكونات العضوية والمعدنية للمكعبات المنتجة حيث قدمت معاملة المواد الخام الطبيعية كمعاملة ذات كفاءة ذات قدرة عالية لتحسين امتصاص العناصر الغذائية (وبخاصة عنصري البوتاسيوم والفسفور). ومن ثم فإنه يوصي باضافة خليط من الإضافات العضوية (مثل سماد الدواجن والطحالب البحرية) و الإضافات المعدنية (مثل صخر الفوسفات, الفلسبار أو جرعة جزئية من السماد المعدني) لتحقيق التكثيف البيئي في نظم الزراعة العضوية.