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RESPONSE OF WHEAT PLANTS TO DIFFERENT ORGANIC EXTRACTS UNDER SANDY SOIL CONDITIONS

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ABSTRACT: A pot experiment was conducted under greenhouse condition at the Experimental Farm, Faculty of Agriculture, Zagazig University, Egypt to investigate spraying with different organic extracts, Moringa leaves extract (MLE); Alge extract (AE); Yeast extract (YE) and Cabbage pollen flowers extract (CPFE) on grains and straw yields, photosynthetic pigments and nutrient uptake of wheat grown on a sandy soil taken from El-Khattara county, Sharkia Governorate, Egypt. Results showed that spraying with different organic extracts significantly increased yield, protein content, photosynthetic pigments and nutrient uptake of N,P,K,Fe,Mn,Zn,and Cu as compared to untreated plants. Spraying with MLE was of most positive effect and caused an increase of all parameters *i.e.,* straw and grain yields, biological yield, protein content, NPK, Fe, Zn, Cu an Mn-uptake of wheat plants compared to other extracts.

Key words: Moringa leaves, yeast extract, alge extract, wheat, sandy soil.

INTRODUCTION

Wheat is the most important cereal crop in the world. In Egypt, there is a great gap between consumption and production of wheat **(FAO, 2011)**. Most of the newly reclaimed soils are sandy, which are poor in available nutrients and organic matter **(Sharpley, 1985)**. The increasing use of chemical fertilizers led to using natural substances and natural plant extracts as fertilizers. The use of inorganic fertilizers is associated with high cost and environmental pollution **(Phiri and Mbewe, 2010)**. Organic extracts are useful for many agriculture purpose (**Veerappan *et al.*, 2019)**. There is continuous need to search for safe natural sources of plant nutrients. *Moringa oleifera* is one of such sources which can be used for growth and yield of crops to substitute inorganic fertilizers (**Phiri and Mbewe, 2010**). It is a highly nutritive plant as fresh vegetable and livestock fodder. It is used as green manure, biogas, medicine, bio pesticide and seed production **(Fuglie, 2000)**. **Elrys and Merwad (2017)** showed that spraying with licorice root extract increased fresh pods yield, dry weight of shoots and seeds, protein content and nutrients uptake of pea plants. Moringa leave's extract gave positive results as a plant growth hormone to enhance seed germination, growth and yield of crops **(Abusuwar and Abohassan, 2017; Abdel-Rahman and Abdel-Kader, 2019)**. Its leaves extract increased crops yields by 25 – 30% **(Martin, 2008). Prabhu *et al.* (2009)** reported that plant height, leaf area and dry herb weight of Kalmegh were increased with foliar spray of 2% extract. **Merwad (2015)** used moringa leaf extract in 4% ethanol on spinach and obtained an increase in each of yield and NPK-accumulation. The highest value for each of straw, grain yield and nutrient uptake by wheat plants was obtained with 4% extract of MLE **(Merwad and Abdel-Fattah, 2017)**. The highest value for each of plant height, leaf area, chlorophyll a, b and caroteniods, yield, NPK-uptake, 1000 grain weight and protein was obtained with falvic acid combined with moringa leaf extract **(Abdel-Fattah and Merwad, 2016).** The use of natural seaweed as fertilizer has allowed for partial substitution of conventional synthetic fertilizer **(Zhang and Ervin, 2004; Khan *et al.*, 2009)**. Some

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commercial seaweed extract products are available for use in agriculture and horticulture and can be used as foliar spray or soil application **(Sharma *et al.*, 2015)**. Algae extracts can be used as bio fertilizers. These extracts are marketed as liquid bio stimulants due to presence of plant growth-promoting substances such as auxins, cytokinins and betaines **(Khan *et al.*, 2009)**. Positive responses include improved germination, root development, leaf quality, general plant vigor, and resistance to pathogens **(Wanas, 2002; Khan *et al.*, 2009)**. Bread yeast *Saccharomyces cerevisiae* is a bio fertilizer usually added to soil or as foliar spray **(Mady, 2009; Hammad and Ali, 2014)**. It contains substances growth regulators such as gibberellins and auxins **(Amer, 2004)** and enzymes **(Abou-Aly, 2005)**. Seaweed extract is rich in nutrients, auxins, gibberellins and cytokinin and helps increasing photosynthesis and improving plant growth (**Kulkarni *et al.*, 2019)**. **Veerappan *et al.* (2019)** found that foliar spraying of 3% horse gram sprout extract or 2% cow pea sprout extract at tillering and seed filling enhanced yield and nutrient uptake of rice. **Desoky *et al.* (2018)** found that foliar spray with bio stimulant increased yield and nutrient uptake of sorghum. **Draz *et al.* (2019)** reported that spraying with extracts of henna, acalypha and lantana increased yield, protein content, chlorophyll oxidative enzymes activities and nutrients in wheat plants. **Abou El-Magd *et al.* (2018)** showed that spraying with cabbage pollen flowers increased growth and yield of cabbage plants. **Mohsen *et al.* (2016)** found that spraying with cyanobacterial extracts increased the plant height, number of leaves/ plant, head weight and yield of lettuce. **Mohamed *et al.* (2019)** found that spraying with algae plus moringa leaf extract increased weight of leaves, N, P, K and bulb of garlic plants. **Mohamed *et al.* (2018)** found that yield, protein content and NPK uptake of wheat increased by foliar spray of yeast extract. The present work was conducted to study the effect of different organic extracts on growth parameters, yield and nutrient uptake of wheat plants grown on a sandy soil.

MATERIALS AND METHODS

A pot experiment was conducted under greenhouse condition at the Experimental Farm, Faculty of Agriculture, Zagazig University, Egypt. The experiment aimed to study the effect of organic extracts of moringa leaves, alge, yeast and cabbage pollen flowers on growth and nutrients uptake of wheat (*Triticum aestivum* L., cv. Sakha 93) grown on a sandy soil.

The soil was taken from the surface layers (0-30 cm) of a field in El-Khattara County, Sharkia Governorate, Egypt. The soil was air dried for 6 days, crushed, sieved to pass through 2 mm plastic screen, thoroughly mixed and stored in plastic bags. Main soil properties are given in Table 1. Soil properties were determined according to **Piper (1950), Black *et al.* (1965) and Jackson (1973).** Pots capacity was 10 kg. Pots dimentions was 25 x 30 cm. Three replicates of the two treated soil performed.

Twenty seeds of wheat were seeded per pot. The pots were daily weighed and the soil moisture content was adjusted nearly the field capacity. After germination, plants were thinned to ten plants.

Nitrogen fertilizer was added as ammonium sulphate (205 g N kg^{-1}) at the rate of 100 mg N kg^{-1} soil in three equal splits. The first was 15 days after seeding, the second and third doses were added at tillering (45 days after seeding) and booting (75 days after seeding). Before seeding, potassium as potassium sulphate (400 g K kg^{-1}) was thoroughly mixed with the soil at a rate of 40 mg K kg^{-1}. Phosphorus was added as ordinary super phosphate (67.6 g P kg^{-1}) at 13 mg P kg^{-1} soil before seeding. Foliar spraying of extracts were done as three equal doses at 30, 45 and 60 days after planting.

Preparation of Organic Extracts

Preparation of moringa leaves extract

Twenty grams of young *Moringa oleifera* leaves was mixed with 675 ml of 80% ethanol as suggested by **Makkar and Becker (1996)**. The suspension was stirred using a homogenizer then filtered using No.2 whatman filter paper. The extract was used within five hours of extraction. The chemical composition of the extract is in Table 2. Moringa leaves extract used for spraying with dilutes of 30 ml extract l^{-1} of water (3%) in the experiment.

Preparation of yeast extract

Commercial baking yeast (*saccharomyces cerevisiae*) was extracted with water adding sugar at ratio1:1 and kept overnight for activation and reproduction of yeast.

Table 1. Main properties of the soil

Soil characteristics	Value
Soil particles size distribution	
Sand (%)	90.5
Silt (%)	6.90
Clay (%)	2.6
Textural class	Sand
Field capacity (FC) (%)	9.31
$CaCO_3$ (g kg^{-1})	4.20
Organic matter (g kg^{-1})	3.60
pH*	7.89
EC (dSm^{-1}) **	0.90
Soluble cations and anions, (mmolc l^{-1}) **	
Ca^{++}	2.85
Mg^{++}	2.65
Na^{+}	1.55
K^{+}	1.95
$CO_3^{=}$	-
HCO_3^{-}	3.56
Cl^{-}	2.98
$SO_4^{=}$	2.46
Available nutrient, (mg kg^{-1}soil)	
N	25.9
P	5.62
K	65.7

*Soil-water suspension 1: 1 ** Soil water extract 1: 1

Table 2. Chemical composition of *moringa oleifera* leaves per dry weight (dw)*

Component	Value	unit
Protein	273	gKg^{-1} dw
Phosphorus (P)	3.90	
Potassium (K)	21.70	
Calcium (Ca)	24.0	
Magnesium (Mg)	4.5	
Iron (Fe)	0.582	
Vitamin A (β-carotene)	163	$mgKg^{-1}$
Vitamin B1 (thiamine)	26	
Vitamin B2 (riboflavin)	210	
Vitamin B3 (nicotinic acid)	800	
Vitamin C (ascorbic acid)	1700	
Vitamin E (tochopherol acetate)	1130	

*According to **Fuglie (2000) and Moyo *et al.* (2011).**

Which allow yeast extract was prepared using a technique yeast cells to grow and multiply, such technique for yeast preparation is after **(Morsi *et al.*, 2008)**. Chemical analysis of yeast extract is presented in Table 3. Yeast extract used for spraying with dilutes of 20 ml extract L^{-1} of water (2%).

Preparation of marine algae extract

Foliar spray of marine algae extract as *Ascophyllum nodosum* (Phaeophyceae) at a rate of 1.0 ml l^{-1}. The chemical composition of marine algae extract is shown in Table 4.

Preparation of cabbage pollen flowers

Extract of cabbage pollen flowers powder was done using water at rate of 10 g L^{-1}. The chemical composition of extract is shown in Table 5.

Determinations of Photosynthetic Pigments

Chlorophylls "a" and "b", as well as carotenoids were extracted by homogenization in pure acetone according to **Fadeels (1962)** and calculated using the formula of **Wettestein (1957)**. Porline was determined according to **Bates *et al.* (1973).**

Plant samples were dried at 70˚C for 72 hr., weighed, ground and analyzed for N, P and K according to **Chapman and Pratt (1961)**. K was measured by flame photometer. Phosphorus was measured colourmetrically using ascorbic acid method **(Watanabe and Olsen, 1965)**.. Protein was calculated by multi plying N% × 5.70 (**Bishni and Hughes, 1979)**.

RESULTS AND DISCUSSION

Growth and Yield Parameters

Results presented in Table 6 show that all extracts increased plant height, straw, grain and biological weights/plant and 1000-grain weight. The highest growth and yield were obtained with moringa leaf extract. Increase in plant height, straw and grain weight, biological weight, 1000 grain weight and protein content were up to of 69, 60,110, 80, 55 and 128%, respectively. These results are in agreement with those obtained by **Veerappan *et al.* (2019)**. Pods and leaves of moringa contains high Ca, Mg, K, Mn, P, Zn, Na, Cu and Fe **(Merwad, 2015; Parađiković *et al.*, 2019)**. Moringa leaf extract was suggested as an effective source of nutrition for plants **(Abd El-Mageed *et al.*, 2017; Abdel-Rahman and Abdel-Kader, 2019).** Since, leaves are rich in nutrients and essential vitamins A, C and E. **Draz *et al.* (2019)** reported that foliar spray with organic extracts of henna, chinaberry, pomegranate and lantana extracts increased yield of wheat.

Wheat treated with organic extracts showed increases in grain yield and 1000- grain weight. Increases in grain yield were 110, 63, 37 and 20% caused by MLE, AE, YE and CPFE, respectively. Highest increases in 1000- grain weigh were 55, 44, 35 and 23%, respectively. These results are in agreement with those obtained by **Abdalla (2013)** who found that plant height, fresh and dry weight of rocket plants increased with foliar spray of 2% moringa leaf extract. **Merwad (2018**) found that spraying with MLE increased fresh pods yield, shoot and seed yields and 100- seed weight of pea. **Merwad and Abdel-Fattah (2017)** found that foliar spray with MLE of 4% caused 77 to 88% increase in wheat grain yield.

Photosynthetic Pigments and Proline

Results illustrated in Fig. 1 show that the extracts exhibited high concentration of chlorophyll a, chlorophyll b, carotenoids and proline. Spraying with MLE caused little increases in the photosynthetic pigments but these increases were comparably.

The highest values for each of chlorophyll a, chlorophyll b, carotenoids, and proline was obtained with MLE. The highest percentage increase in each of chlorophyll a, chlorophyll b, carotenoids, and proline were 59, 91, 127 and 98%, respectively. These results are in agreement with those obtained by **Abd El-Mageed *et al.* (2017), Bulgari *et al.* (2019), Parađiković *et al.* (2019), Mohamed *et al.* (2018), Mohamed *et al.* (2019) and Ullah *et al.* (2019)**.

Anaysis of MLE indicates that it can be used as a plant biostimulant. It contains nutrients, proline, ascorbic acid, indol-3-acetic acid (IAA), gibberellins (GA) and cytokinin. Percentage increase of 60, 39, 31 and 21% were caused by MLE, AE, YE and CPFE, respectively for pigments and 98, 80, 74 and 48%, respectively for

Table 3. Chemical composition of activated yeast (mg^{-1} g dry weight)*

Mineral	Value	Amino acid	Value	Vitamin	Value
Total N	7.23	Arginine	1.99	Thiamin	2.71
P_2O_5	51.68	Histidine	2.63	Riboflavin	4.96
K_2O	34.39	Isoleiucine	2.31	Nicotinic acid	39.88
MgO	5.76	Leucine	3.09	Pantothenic acid	19.56
CaO	3.05	Lysine	2.95	Biotin	0.09
SiO_2	1.55	Methionine	0.72	Pyridoxine	2.90
SO_2	0.49	Phrnylalanine	2.01	Folic acid	4.36
NaCl	0.30	Theronine	1.09	Cobalamin	153 ug-^{1}g
Fe	0.92	Tryptophan	0.45	**Enzymes**	
Ba	157.6	Valine	2.19	Oxidase	0.350
Co	67.8	Glutamic acid	2.00	Peroxidase	0.290
Mn	81.3	Aspartic acid	1.33	Catalase	0.063
Zn	335.6	Proline	1.53	Carbohydrates	23.20

*According to **Mady (2009)**

Table 4. The chemical composition (%) of marine algae extract

Characteristic	N	P	K	Ca	Mg	Fe, Ppm	Alginic acid	Cytokinine	Indol acetic acid	Pepsin	Oligo saccharide	Phytin
Value	1.33	0.46	12.40	0.55	0.35	80	5.60	0.001	0.002	0.02	3.50	0.003

Table 5. The chemical composition (%) of cabbage pollen flowers.

Characteristic	N	P	K	Ca	Mg	Fe, Ppm	Alginic acid	Cytokinine	Indol acetic acid	Pepsin	Oligo saccharide
Value	1.20	0.46	12.40	0.68	0.44	90	4.7	0.002	0.003	0.04	3.2

*According to **Abou El-Magd *et al.* (2018)**

Table 6. Effect of organic extracts on plant height and yield of wheat plants grown in sandy soil

Treatment	Plant height (cm)	Straw weight (g $plant^{-1}$)	Grain weight (g $plant^{-1}$)	Biological weight (g $plant^{-1}$)	1000 - grain weight (g)	Harvest index (%)	Protein content (g kg^{-1})
Control	62.17	1.03	0.75	1.78	35.77	42.02	63.7
MLE	105	1.63	1.58	3.21	55.57	49.12	144
AE	95.63	1.36	1.22	2.58	51.33	47.17	134
YE	88.20	1.22	1.03	2.25	48.20	45.84	115
CPFE	74.03	1.15	0.90	2.05	43.83	43.86	104
Mean	85.07	1.28	1.09	2.37	46.94	45.60	112
LSD 0.05%	1.6	0.21	0.18	0.12	1.02	1.1	1.4

MLE: Moringa leaves extract; AE: Alge extract; YE: Yeast extract; CPFE: Cabbage pollen flowers extract

Praline (Table 7). These results are in agreement with those obtained by **Desoky *et al.* (2017)** who found that spraying with MLE gave high photosynthetic pigments and proline of pea plants under soil salinity stress. *Moringa oleifera* ascertains its effect on growth and yield of crops **(Abusuwar and Abohassan, 2017; Merwad and Abdel-Fattah, 2017; Thanaa *et al.,* 2017; Bulgari *et al*., 2019; Ullah *et al.,* 2019)**. Moringa leaf extract is rich in amino acids, K, Ca, Fe, ascorbate and growth regulating hormones and is an ideal plant growth enhancer. Different parts of this plant contains important minerals, proteins, vitamins, carotene, amino acids and various phenolics Therefore it is a good source of natural antioxidants (**Desoky *et al.,* 2018)**. **Merwad (2019)** obtained the highest value for each of plant growth, chlorophyll a, b and caroteniods, NPK-uptake, 1000-grain weight and protein content of wheat with humus materials combined with moringa extract spray under salinity stress.

Macro-Nutrient Uptake

Results in Table 8 show the effect of foliar spraying with the extracts which increased NPK-uptake. These results are similar to those of **Mohamed *et al.* (2018), Toscano *et al.* (2019) and Veerappan *et al.* (2019)**. The highest values of straw and grain NPK-uptake of wheat was obtained under spraying with MLE. The current results are similar to those of **Mohamed *et al.* (2018) and Parađiković *et al.* (2019)**.

The promotive effect of the extracts on NPK-uptake may follow the order: MLE> AE> YE> CPFE. The favourable effect of organic extract on nutrient content is mainly due to the positive effect of this material on increasing the growth parameters, photosynthetic pigments and nutrient content **(Merwad, 2017; Mohamed *et al.,* 2018; Toscano *et al.,* 2019)**.

All extracts caused increases in uptake of plant nutrients. Highest increases of 317, 220, 143 and 101% were given by MLE, AE, YE, CPFE, respectively for N-uptake by straw and 280, 153, 79 and 43% , respectively for P-uptake and 306, 179, 125 and 75%, respectively for K-uptake.

The main actions of extracts are: a) enhance growth of plants, b) contain higher times of nutrients, amino acids, antioxidants, antiaging and anti-inflammatory materials, proteins, vitamins and different minerals **(Bulgari *et al*., 2019; Mohamed *et al.,* 2019; Parađiković *et al.,* 2019)**.

Micro Nutrient Uptake

Results of Table 9 show that all extracts gave increases in Fe, Zn, Mn and Cu uptake. These results agree with that obtained by **Selvam and Sivakumar (2014), Merwad (2017), Mohamed *et al.* (2018) and Bulgari *et al*. (2019)**.

The highest uptake for each of Fe, Zn, Mn and Cu was obtained by MLE. The highest percentage increase in Fe, Zn, Mn and Cu uptake were 197, 222, 192 and 150%, respectively in straw as well as 267, 313, 270 and 200%, respectively in grains. These results are in agreement with those obtained by **Mohsen *et al.* (2016) and Parađiković *et al.* (2019)** who found that tomato treated with bio stimulants had greater contents of N, P, K, Ca, and Mg.

Table 7. Effect of organic extracts on Photosynthetic pigments (mg g-1f wt) and proline of wheat plants in sandy soil

Treatment	Chlorophyll a	Chlorophyll b	Carotenoids	Proline (µg g^{-1} DW)
Control	1.02	0.45	0.33	20.73
MLE	1.63	0.86	0.75	40.98
AE	1.42	0.72	0.61	37.35
YE	1.34	0.65	0.53	36.01
CPFE	1.23	0.57	0.44	30.73
Mean	1.33	0.65	0.53	33.16
LSD 0.05%	0.02	0.05	0.03	0.79

Se footnote of Table 6.

Table 8. Effect of organic extracts on N, P and K-uptake (mg plant^{-1}) of wheat plants grown in sandy soil

Treatment	Straw			Grains		
	N	P	K	N	P	K
Control	9.33	1.79	8.80	8.32	1.51	5.73
MLE	38.96	6.81	35.77	39.83	8.66	30.15
AE	29.88	4.54	24.60	28.59	5.35	21.10
YE	22.71	3.21	19.80	20.77	3.45	16.68
CPFE	18.82	2.56	15.41	16.36	2.76	11.70
Mean	23.94	3.78	20.87	22.77	4.34	17.07
LSD 0.05%	1.23	0.84	1.32	1.05	0.25	0.98

See footnote of table (6)

Table 9. Effect of organic extracts on micronutrient uptake (mg plant^{-1}) of wheat plants grown in sandy soil

Treatment	Straw				Grains			
	Fe	Zn	Mn	Cu	Fe	Zn	Mn	Cu
Control	97.99	40.06	79.36	5.44	78.14	31.91	63.50	4.87
MLE	292	129	232	32.71	287	132	235	33.86
AE	205	94.69	172	22.08	197	89.77	162	21.30
YE	162	74.81	142	15.66	147	70.92	127	14.82
CPFE	131	59.61	107	11.35	112	52.69	93.17	11.13
Mean	178	79.67	147	17.45	164	75.43	136.13	17.20
LSD 0.05%	2.92	3.26	4.65	1.42	3.40	2.71	2.53	1.02

See footnote of table (6)

Significant increases in Fe, Zn and Mn uptake occurred upon spraying with extracts. Highest percentage increases valued 197, 109, 65 and 43% were caused by MLE, AE, YE, CPFE, respectively in straw. Fe-uptake; 222, 136, 86 and 48%, respectively for Zn-uptake and 192, 116, 78 and 34%, respectively of straw Mn-uptake. Important plant hormones like Auxins, Gibberellins and Cytokinin existing in the extracts induce cell division and increase cell enlargement and lead to balance physiological (**Merwad, 2017; Desoky *et al.,* 2018.)**

Organic extracts have been used in agriculture and horticulture as bio stimulants to promote plant growth and increase crop yields **(Veerappan *et al.,* 2019)**

Conclusion

The results of this study indicate that foliar spray on wheat with extracts of Moringa leaves extract (MLE); Alge extract (AE); Yeast extract (YE) and Cabbage pollen flowers extract (CPFE) had beneficial effects on plant growth, yield, macro and micro nutrient uptake. Increases were the highest with MLE in all parameters, straw and grains yield, biological yield, protein content, NPK, Fe, Zn, Cu and Mn-uptake of wheat plants.

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استجابة نباتات القمح للمستخلصات العضوية المختلفة تحت ظروف أرض رملية

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أجريت تجربة أصص تحت ظروف محكمه في صوبة كلية الزراعة، جامعة الزقازيق، جمهورية مصر العربية، كان الهدف من الدراسة هو استكشاف تأثير الرش بالمستخلصات العضوية المختلفة (مستخلص أوراق الموريجنا، مستخلص الطحالب، مستخلص الخميرة، مستخلص حبوب لقاح أزهار الكرنب) على محصول القمح، بعض الصفات الفسيولوجية وامتصاص العناصر الغذائية تحت ظروف الأراضى الرملية، تم أخذ عينات من الطبقات السطحية للتربة (صفر -٣٠ سم) من مزرعة الخطارة- محافظة الشرقية، مصر، وأظهرت النتائج أن الرش بالمستخلصات العضوية المختلفة أعطت زيادة معنوية في المحصول ومحتوى البروتين والصفات الفسيولوجية والعناصر الغذائية الممتصة بواسطة نباتات القمح مقارنة بالنباتات غير المعاملة (الكنترول)، الرش بمستخلص أوراق المورينجا أعطى أعلى قيم لجميع الصفات مثل المحصول، المحصول البيولوجى، محتوى البروتين، النيتروجين والفوسفور والبوتاسيوم الممتص وكذلك الحديد والزنك والمنجنيز والنحاس الممتص بواسطة القمح مقارنة بالمستخلصات العضوية الأخرى.

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