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B. Effect of Zeolite and Magnetite Combined with Biofertilizers mitigate Water Deficiency on *Oenothera biennis* plant biochemical components

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ABSTRACT

Upon the theory of safety production of medicinal and aromatic plants particularly under water deficiency present experimental research was conducted in pots for two seasons continuously to compare the effects of biofertilizers, soil additives, mixture of them, and chemical NPK fertilizer (control) on biochemical ingredients, symbolized in (plant pigments, total carbohydrates, total phenolics, micro and macro elements compared with the recommended dose of chemical fertilizer NPK (control) under water deficiency. our results revealed that mixture of biofertilizers and soil additives (zeolite& magnetite) led to significant increment in biochemical components in comparison with the recommended dose of chemical fertilizer NPK (control) under the same conditions. These results disclose that mixture biofertilizers and natural resources of soil amendments could reduce or replace the addition of chemical fertilizers, accordingly improve the quality and quantity of medicinal and aromatic plants, besides minimizing economic costs and pollution of the agricultural environment.

Keywords: Evening primrose, Soil additives, Biofertilizers, biochemical ingredients.

1. Introduction

Nowadays the time period “opportunity medicine” have become very common in western tradition, it cognizance at the concept of the use of the plants for medicinal reason. However the contemporary belief that drugs which come in pills or drugs are the only drugs that we will consider and use. Nevertheless most of these pills and tablets we take and use all through our everyday lifestyles came from plants. Medicinal vegetation regularly used as raw substances for extraction of lively components which used within the synthesis of various tablets. Like in case of laxatives, blood thinners, antibiotics and antimalaria medicines, include ingredients from plant life. Furthermore the lively substances of Taxol, vincristine, and morphine remoted from foxglove, periwinkle, yew, and opium poppy, respectively.

Plants had been used for medicative functions protracted before recorded history. Primitive guys found and favored the nice type of flora to be had to them. Plants offer food, apparel, refuge, and medicament. A full ton of the medicative use of vegetation seems to be advanced via observations of wild animals, and with the help of trial and mistakes. As time went on, each tribe additional the medicative strength of herbs of their place to its experience base. They methodically concentrated statistics on herbs and advanced nicely-described natural pharmacopoeias. The terminology “Medicinal Plant”, also called “Medical Herbs”, encompasses diverse forms of flowers used in herbalism ("herbology" or "herbal medicinal drug"). It’s far the use of flowers for medicinal purposes, and the study of such uses. The phrase “herb” has been derived from the Latin word, “herba” and a vintage French word “herbe”. Nowadays, herb refers to any part of the plant like fruit, seed, stem, bark, flower, leaf, stigma or a root, as well as a non-woody plant. Earlier, the term “herb” was simplest applied to non-woody plant life, such as people who come from trees and shrubs. These medicinal floras are also used as food, flavonoid, medication or fragrance and additionally in certain spiritual sports. Vegetation

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was used for medicinal purposes lengthy earlier than prehistoric period.

It was mentioned that the plants tolerant to drought stress show different responses, including increment root/shoot ratio, growth reduction, leaf anatomy change, reduction of leaf size, total leaf area to limit water loss and guarantee photosynthesis Toscano *et al.* (2019). The reduction of photosynthetic activity is related to the mechanisms of stomatal conductance. So, the first response of plants to water stress is stomatal closure for water potential adjustment resulting in a reduction in photosynthetic activity, which in turn leads to a decrease in plant growth and production Shi *et al.* (2019)**.**

Zeolites overcome the effects of drought in arid regions by acting as water distributors throughout the soil, that in turn affecting water conduction in plants Ghazavi (2015). Also, Rastogi *et al*., (2019) mentioned that nano zeolites may be effectively used in agriculture to facilitate water infiltration and retention in the soil due to their porous and capillary properties which act as a slow-release source for water as well as macro and microelements into the environments. Hidayat *et al.* (2015) evaluated zeolite as slow release fertilizer nitrogen from urea. The results concluded that the zeolite is capable of retarding the release of urea and potential to be developed as a control release of nitrogen from urea.

Magnetite is a natural row rock that has very high iron content, Magnetite has a black or brownish-red, and it has hardness about 6 on the Mohs hardness scale, it is one of two natural row rocks in the world that is naturally magnetic Mansour (2007). Taha *et al*. (2011). Also, magnetic iron increased plant growth and leaf mineral content on cauliflower Mansour (2007) and in Roselle plants (*Hibiscus Sabdariffal*), Yasser *et al*. (2011) In addition, application of a magnetic field to irrigation water was shown to increase plant nutrient content, Moon and Chung (2000).

Microorganisms in the form of biofertilizers exist in pure or mixed product containing cells of microorganisms which perhaps nitrogen fixers, solubilizers of phosphorus, sulphur oxidisers or organic matter decomposers have served the human beings to correct problems emerge as a result of their synthetic products and its remarkable effects in human and animal health, food processing safety and quality, environmental and ecosystem. Hence soil microbiologists and microbial ecologists have separated many beneficial microorganisms which play essential role in soil quality, plant growth and yield, can fix atmospheric nitrogen, decomposes organic compounds, remove toxic substances from pesticides, repress plant diseases and soil-borne pathogens, boost nutrient cycling and produce bioactive materials like vitamins, hormones and enzymes that stimulate plant growth. T.Satyanarayana and Bhavdish Narain Johri (2012).

Oenothera biennis L. (Evening primrose) belongs to family Onagraceae. It is an edible and medicinal plant and has a long history of use as an alternative medicine.
Evening primrose is a biennial with a roselte of long oval leaves in the first year and a vertical hairy stem with spear-shaped soft leaves in the second year. Yellow flowers, reputed to open only after 6 o'clock in the evening, appear in midsummer. Ghasemnezhad and Honermeier (2007) reported that some *Oenothera* species grown as oil seed crops and to provide drugs for the pharmaceutical industry. Wettasinghe *et al.*, (2002) reviewed various constituents isolated from *Oenothera species*. These include steriods, terpenoids, fatty acids, flavonoids, tannins, mucilage, resin, bitter principle and potassium salts.

The purpose of present research was to examine the effect of zeolite and magnetite combined with biofertilizers on *Oenothera biennis* L. *(*evening primrose) plant subjected to water deficiency and grown in sandy soil compared with commercial NPK fertilizers.

2. Material and Methods

Present investigation was carried out at the nursery of ornamental department; faculty of agriculture, Giza, Egypt, during two frequently seasons (2015/2016 and 2016/2017). Mechanical and chemical analyses of the reclaimed soil were performed according to Richards (1954) and Jackson (1973) as shown in Table (1) at Soil, Water and Environment Research Institute, Agriculture Research Centre (A.R.C).

Table 1: Some physical and chemical properties of soil experimental

Physical properties		**Chemical properties**	
Particle size distribution (%)		Electrical conductivity (EC) [dS/m]	1.68
Coarse sand 2000–200 µ	80.20	pH (1:2.5) soil : water suspension	7.68
Fine sand 200–20 µ	12.50	Soluble cations [meq/l]:	
Silt 20–2 µ	4.25	Ca^{2+}	5.20
Clay < 2 µ	3.05	Mg^{2+}	4.18
Bulk density [g/cm^3]	1.52	K^+	2.40
Total porosity [%]	52.8	Na^+	5.20
Pore size distribution as % of total porosity		**Soluble anions (meq/l):**	
Macro (drainable) pores (> 28.8 µ)	82.98	CO_3^{2-}	0
Micro pores (< 28.8 µ)	17.02	HCO^{3-}	1.7
Water Holding Capacity (WHC)*	20.33	Cl^-	3.6
Field capacity (FC)*	8.55	SO_4^{2-}	11.50
Wilting percentage (WP)*	4.10	Total $CaCO_3$ [%]	0.2
Available moisture (FC-WP)*	4.45	Organic matter [%]	0.2
Hydraulic conductivity [cm/h]	6.25		

Oenothera biennis L. seeds were obtained from experimental farm of Faculty of Pharmacy, Cairo University, and sown in pots (35 cm) at the end of October and harvested in May in both seasons.

2.1. Chemical fertilizers were added at the rate of 150 k/fed as ammonium nitrate (33%) both Calcium superphosphate (15.5%) at the rate of 60 k/fed and Potassium sulphate (48%) at the rate of 60 k/fed were added one day before transplanting.

2.2. Zeolite and compost

Zeolite was added at the rate of 210 k/fed. It was loaded with nitrogen as granules while compost added at the rate 5 ton /fed. Both added 15 days before transplanting and were obtained from Soil Department in the A.R.C as shown in Table (2, 3).

Table 2: Chemical composition of zeolite

Chemical composition (%)												
SiO_2	**TiO_2**	**Al_2O_3**	**Fe_2O_3**	**FeO**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**SrO**	**P_2O_3**	**N**
45.50	2.81	13.30	5.40	8.31	0.51	6.30	9.52	2.83	0.87	0.22	0.67	2.70
Trace elements (ppm)												
Ba	**Co**	**Cr**	**Se**	**Cu**	**Zn**	**Zr**	**Nb**	**Ni**	**Rb**	**Y**	**-**	**-**
10	1.2	35	0.8	19	64	257	13	55	15	22	-	-

Table 3: Chemical composition of compost

Chemical analysis							
pH (1:5)	**EC (1: 5 extract) ds/m**	**Organic matter (%)**	**Organic-C %**	**Total content of Bacteria**	**Phosphate dissolving Bacteria**	**Humidity (%)**	**Weed seeds**
7.5	3.1	44.3	25.5	2.5 x 10^7	2.5 x 10^4	20	0
Chemical analysis							
Total-N %	**Total-K %**	**Total-P %**	**C/N ratio**	**Fe Ppm**	**Mn Ppm**	**Cu ppm**	**Zn ppm**
1.82	1.25	1.06	18.1	784.12	96.31	31.05	251.23

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2.3. Magnetite

Magnetite added to the soil (150 kg/fed.), added one week before transplanting. It was provided from El-Ahram Company for Mining- Egypt as shown in Table (4).

Table 4: Some Physical and Chemical Properties of Magnetite

Physical Properties	
Color	Black to silvery gray
Streak	Black.
Luster	Metallic to sub metallic.
Diaphaneity	Opaque.
Mohs Hardness	5 to 6.5
Specific Gravity	5.2
Diagnostic Properties	Strongly magnetic, color, streak, octahedral crystal habit.
Tenacity	Brittle.
Fracture	Sub conchoidal to uneven.
Transparency	Opaque.
Crystal System	Isometric.
Uses	The most important ore of iron.
Chemical composition	
Chemical formula	Fe_3O_4.
Chemical Composition	Fe++, Fe+++.
	Mn, Zn, Mg (trace).

2.4. Biofertilizers

Mixture of biofertilizers (*Bacillus megaterium* and *Azotobacter chroococcum*) were obtained from Soils Water and Environ. Res. Inst., Dept. of Microbiology (A. R. C.), Giza, Egypt.

Treatments

1	NPK control	**7**	Magnetite 50% + Bio
2	Magnetite 50%	**8**	Magnetite 100% + Bio
3	Magnetite 100%	**9**	Zeolite 50% + Bio
4	Biofertilizers	**10**	Zeolite 100% + Bio
5	Zeolite 50%	**11**	Magnetite 50% + Zeolite 50%+ Bio
6	Zeolite 100%	**12**	Magnetite 100% + Zeolite 100%+ Bio

2.5. Fixed oil content (% of the seeds):

Fixed oil extracted from seeds by using a Soxhlet apparatus. The oil percentage was determined according to the methylation (change fixed oil into fatty acid) and G.L.C analysis was also recorded by G.C. mass in Medicinal and Aromatic Plant Laboratory. Dokki (A.R.C) according to Kinsella, J.E., 1966 then oil yield/ha was estimated in a hectare.

2.6. Data recorded

2.6.1. Chemical Analysis

2.6.1.1. Total chlorophylls and Carotenoid

Total chlorophylls and carotenoid contents (mg/g fresh weight) were measured by the spectrophotometer and calculated according to the equation described by Moran (1982).

2.6.1.2. Total carbohydrates (%)

In plant leaves and seeds were determined by the phosphomolybdic acid method as reported by A.O.A.C. (1990).

2.6.1.3. Nitrogen

The total nitrogen content of the dried material (leaves and seeds) was determined by using the modified- micro-Kjeldahl method as described by A.O.A.C (1990).

2.6.1.4. Phosphorus

Phosphorus was determined calorimetrically by using the chlorostannate molybdophosphoric blue color method in sulfuric acid according to Jackson (1973).

2.6.1.5. Potassium

Potassium concentrations were determined by using the flame photometer apparatus (CORNING M 410, Germany).

2.6.1.6. Calcium, iron, and zinc concentrations

Were determined using Inductively Coupled Plasma Emission Spectrometer "ICP" The Agilent 720/730 series US.

2.6.1.7. Total phenolics content in seed

Soluble phenolics were extracted five times from defatted ground seed into aqueous 80% (vol. /vol.) methanol (at a ratio of 1:1, wt./vol.) at room temperature for 1 h using an orbital shaker at 250 rpm. The mixture was centrifuged at 1750 × *g* for 10 min, and the supernatants were collected, combined, evaporated to near dryness under vacuum at ≤40°C, and lyophilized. Phenolic acids present in the crude extract were fractionated into free and bound forms according to the procedure described by Kozlowska *et al*. (1983) and Zadernowski (1987).

2.7. Statistical analysis

The experimental design was Randomized Complete Blocks Design (RCBD) with ten replicates. The data were analyzed using ANOVA at 5% significance level, the difference between treatments, then analyzed using DMRT (Duncan Multiple Range Test) at 5%.

3. Results and Discussion

As declared of growth parameters data, the results of chemical analysis Tables (5,6) had the same way that, concentrations of macro and micronutrients in the shoot of *Oenothera biennis* plant through both seasons significantly increased as a result of mixture application treatment (Magnetite 100% + Zeolite 100%+ Biofertilizers) compared with control plants, the augmentations during first season were (78, 38%) for nitrogen, (57, 60 %) for phosphorus, (22, 23%) for potassium, (30, 30.2%) for calcium, (69, 67%) for iron and (40, 35%) for zinc under 50% and 100% irrigation water respectively.

Table 5: Effect of magnetite, biofertilizers and zeolite on N, P and K concentration in leaves of *Oenothera biennis* plant under 50 or 100% water irrigation regime during first season

Treatment	N%		P%		K%	
	50%	100%	50%	100%	50%	100%
NPK control	1.38d	2.02b	0.14d	0.15c	0.22b	0.21b
Magnetite 50%	1.32d	1.63e	0.12d	0.13d	0.19c	0.18c
Magnetite 100%	1.41c	1.74d	0.13d	0.15c	0.20c	0.19c
Biofertilizers	0.78e	1.45f	0.09e	0.11d	0.17d	0.16c
Zeolite 50%	1.46c	1.78d	0.16c	0.18b	0.21b	0.20b
Zeolite 100%	1.55b	1.87c	0.16c	0.18b	0.22b	0.23a
Magnetite 50% + Bio	1.43c	1.85c	0.18b	0.19b	0.22b	0.20b
Magnetite 100% + Bio	1.42c	1.86c	0.19b	0.20a	0.22b	0.22b
Zeolite 50% + Bio	1.57b	1.89c	0.17c	0.19b	0.22b	0.21b
Zeolite 100% + Bio	1.60b	1.92c	0.19b	0.20a	0.22b	0.22b
Magnetite 50% + Zeolite 50%+ Bio	2.31a	2.63a	0.20a	0.21a	0.25a	0.24a
Magnetite 100% + Zeolite 100%+ Bio	2.47a	2.79a	0.22a	0.24a	0.27a	0.26a

Means with the same letter in a column are not significantly different by DMRT at level 5%

Table 6: Effect of magnetite, biofertilizers and zeolite on calcium, iron and zinc of *Oenothera biennis* plant under 50 or 100% water irrigation regime during first season

Treatment	Ca%		Fe (ppm)		Zn (ppm)	
	50%	100%	50%	100%	50%	100%
NPK control	1.40f	1.42d	143.08d	149.12d	39.24d	44.86c
Magnitite 50%	1.43f	1.46d	201.12b	205.18c	39.35d	41.57c
Magnitite 100%	1.47f	1.50c	202.07b	208.11c	40.30c	44.62c
Biofertilizers	1.38g	1.41d	131.40e	138.47e	32.40e	36.82d
Zeolite 50%	1.67d	1.70b	197.93c	203.07c	47.52c	50.84b
Zeolite 100%	1.70c	1.72b	196.85c	201.13c	50.34b	52.66a
Magnetite 50% + Bio	1.52e	1.55c	201.11b	211.52b	42.08c	47.15b
Magnetite 100% + Bio	1.55e	1.58c	203.12b	216.77b	43.16c	49.28b
Zeolite 50% + Bio	1.69c	1.72b	202.19b	207.26c	54.07b	57.13a
Zeolite 100% + Bio	1.71c	1.74b	205.78b	208.93c	54.40b	57.72a
Magnitite 50% + Zeolite 50%+ Bio	1.78b	1.81a	240.65a	244.57a	55.60b	58.91a
Magnitite 100% + Zeolite 100%+ Bio	1.82a	1.85a	242.75a	249.61a	58.51a	60.83a

Means with the same letter in a column are not significantly different by DMRT at level 5%

Same trend was found in the second season tables (7, 8) where application of mixed treatment (Magnetite 100% + Zeolite 100%+ Biofertilizers) raised concentration by (77, 40%) for nitrogen, (53, 64%) for phosphorus, (19, 26%) for potassium, (36, 30.5%) for calcium, (75, 72%) for iron, (57, 35%) for zinc during second season under 50% and 100% irrigation water respectively.

Table 7: Effect of magnetite, biofertilizers and zeolite on N, P and K concentration in leaves of *Oenothera biennis* plant under 50 or 100% water irrigation regime during second season

Treatment	N%		P%		K%	
	50%	100%	50%	100%	50%	100%
NPK control	1.36d	2.11b	0.15d	0.17c	0.21b	0.23c
Magnetite 50%	1.33d	1.71e	0.13d	0.15c	0.18c	0.20d
Magnetite 100%	1.40c	1.86d	0.13d	0.17c	0.19c	0.22d
Biofertilizers	1.06e	1.57e	0.10e	0.12d	0.18c	0.19d
Zeolite 50%	1.45c	1.87d	0.15d	0.21b	0.22b	0.23c
Zeolite 100%	1.53b	1.96c	0.18c	0.20b	0.23a	0.25b
Zeolite 50% + Bio	1.56b	1.98c	0.18c	0.23b	0.21b	0.23c
Zeolite 100% + Bio	1.58b	2.04b	0.18c	0.25a	0.24a	0.24b
Magnetite 50% + Bio	1.42c	1.96c	0.17c	0.20b	0.21b	0.23c
Magnetite 100% + Bio	1.44c	1.98c	0.18c	0.22b	0.21b	0.23c
Magnetite 50% + Zeolite 50%+ Bio	2.30a	2.85a	0.20b	0.21b	0.23a	0.26b
Magnetite 100% + Zeolite 100%+ Bio	2.41a	2.95a	0.23a	0.28a	0.25a	0.29a

Means with the same letter in a column are not significantly different by DMRT at level 5%

Table 8: Effect of magnetite, biofertilizers and zeolite on calcium, iron and zinc of *Oenothera biennis* plant under 50 or 100% water irrigation regime during second season

Treatment	Ca%		Fe ppm		Zn ppm	
	50%	100%	50%	100%	50%	100%
NPK control	1.28f	1.41f	140.02e	147.19e	37.58d	47.21d
Magnitite 50%	1.37e	1.45f	204.09c	203.12d	33.62d	44.13d
Magnitite 100%	1.39e	1.51e	206.13c	211.15d	33.71d	49.46d
Biofertilizers	1.26f	1.40f	129.26f	140.58e	34.25d	39.50e
Zeolite 50%	1.60c	1.72c	193.78d	208.16d	45.93c	53.35c
Zeolite 100%	1.66b	1.72c	198.26d	220.19c	52.51b	55.57b
Zeolite 50% + Bio	1.64b	1.73b	211.31b	219.13c	52.88b	56.70b
Zeolite 100% + Bio	1.68b	1.74b	213.46b	228.62b	57.12b	58.21b
Magnetite 50% + Bio	1.40d	1.57d	193.22d	215.16c	43.46c	50.42c
Magnetite 100% + Bio	1.43d	1.58d	206.17c	218.09c	45.29c	50.35c
Magnitite 50% + Zeolite 50%+ Bio	1.66b	1.80a	242.33a	249.44a	54.38b	59.62b
Magnitite 100% + Zeolite 100%+ Bio	1.75a	1.84a	246.11a	253.22a	59.22a	63.59a

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Mixture treatment caused a considerable change in the soil pH and that would have a significant increase in macro and micronutrients availability (N, K, P, Ca, Fe and Zn) to plant roots, increased their uptake which increased the number of chloroplast per cell as well as photosynthetic efficiency and increased sugar content in plants Mahmoud and Swaefy (2020).

It has been known that, existing N in soil is strongly related to the capacity of plant roots to absorb water from soil. Nevertheless a few types of soils are poor in N content especially in arid and semi arid regions that may make the plants more vulnerable to drought stress taking place in these regions Mahmoud and Swaefy (2020), Moreover, drought provoked N deficiency mainly hinders plant growth under water deficit Heckathorn *et al.* (1997) represented in decreasing leaf size due to decreased cells number and size beside the whole plant shoot Macadam *et al.* (1989). Meanwhile, The ameliorative effects of N, P and K together on plant growth under drought have been ascribed to an enhancement in stomatal conductance Brück *et al.* (2000), photosynthesis Ackerson (1985), higher cell-membrane constancy, enhanced plant water positive relation and raised drought tolerance Mahmoud and Swaefy (2020) also increased of micronutrients uptake such as Zn, Cu, Mn, and Fe Bagayoko *et al.* (2000).
Escalating macro and micronutrient concentrations in *Oenothera biennis* plant leaves as a result of mixed treatment application may be owing to the extent in root surface per unit of soil volume which in turn contribute greatly to the enhance of nutrient uptake Mahmoud and Swaefy (2020), along with the essential role of zeolite which containing macro and micronutrients, and its channels that grant large surface areas on which chemical reactions can take place and turn fertilizers to be more effective by preventing leeching and holding important elements such as ammonium, potassium, magnesium and calcium as well as trace nutrients as slow release as required Kallo and Terbe (1986).

Values of total carbohydrate, photosynthetic pigments (carotenoids content and total chlorophyll) and total phenols in leaves of *O. biennis* (Tables 9,10) showed significant differences in comparison with the control treatment, the most effective treatment in this respect was the mixture application (Magnetite 100% + Zeolite 100%+ Biofertilizers) since total chlorophyll increased by (250, 221%), (147, 93%) for carotenoids, (61, 41%) for total carbohydrate, and (28, 34%) for total phenols during first season under 50% and 100% irrigation water respectively in comparison with control plants**.**
Focusing on data from second season (Table10), application of mixed treatment (Magnetite 100% + Zeolite 100%+ Biofertilizers) boosted total chlorophyll by (232, 103 %), (154, 62%) for carotenoids, (74, 42 %) for total carbohydrate, and (28,19%) for total phenols during second season under 50% and 100% irrigation water respectively in comparison with control plants**.**

Table 9: Effect of magnetite, biofertilizers and zeolite and their combinations on total Chlorophylls (mg/g) as well as Carotenoids(mg/g), total carbohydrates(mg/g) and total phenols (mg GAE eq. /g) of *Oenothera biennis* plant under 50 or 100% water irrigation regime during first season 2015/2016.

Treatment	Total Chlorophyll (mg/g)		Carotenoids (mg/g)		Total carbohydrates in leaves (%)		Total phenols (mg GAE eq. /g)	
	50%	100%	50%	100%	50%	100%	50%	100%
NPK control	0.532f	0.653d	0.215d	0.325e	6.53d	8.62d	2.75b	1.96c
Magnetite 50%	0.541f	0.662d	0.256d	0.366e	6.22d	8.31d	3.22a	2.03b
Magnetite 100%	0.612e	0.730d	0.321c	0.411d	6.46d	8.55d	3.11a	2.02b
Biofertilizers	0.405g	0.517e	0.169e	0.279f	4.09e	6.18e	2.72b	1.91c
Zeolite 50%	0.657e	0.779d	0.323c	0.433d	6.87d	8.96d	3.21a	2.10b
Zeolite 100%	0.863c	0.985c	0.352c	0.462d	7.15c	9.24c	3.35a	2.14b
Magnetite 50% + Bio	0.702d	1.011c	0.412b	0.502c	7.68c	9.79c	3.14a	2.05b
Magnetite 100% + Bio	0.747d	1.069b	0.457b	0.577c	8.22b	10.31b	3.26a	2. 07b
Zeolite 50% + Bio	0.966b	1.388b	0.471b	0.581c	8.05b	10.14b	3.24a	2.17b
Zeolite 100% + Bio	0.972b	1.574b	0.512a	0.602b	8.79b	10.88b	3.26a	2.17b
Magnetite 50% + Zeolite 50%+ Bio	1.232a	2.014a	0.510a	0.620a	9.82a	11.91a	3.42a	2.60a
Magnetite 100% + Zeolite 100%+ Bio	1.864a	2.096a	0.529a	0.629a	10.53a	12.62a	3.51a	2.63a

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Table 10: Effect of magnetite, biofertilizers and zeolite and their combinations on total Chlorophylls (mg/g) as well as Carotenoids(mg/g), total carbohydrates(mg/g) and total phenols (mg GAE eq. /g) of *Oenothera biennis* plant under 50 or 100% water irrigation regime during second season 2015/2016

Treatment	Total Chlorophyll (mg/g)		Carotenoids (mg/g)		Total carbohydrates in leaves (%)		Total Phenols (mg GAE eq. /g)	
	50%	100%	50%	100%	50%	100%	50%	100%
NPK control	0.520d	1.101b	0.206d	0.511d	5.64e	9.11d	2.77b	1.93b
Magnetite 50%	0.528d	0.739e	0.245d	0.433e	4.33f	9.06d	3.25a	1.01b
Magnetite 100%	0.588d	0.853d	0.312c	0.475e	5.57e	9.53d	3.19a	2.97a
Biofertilizers	0.391e	0.729e	0.158e	0.312f	3.48g	7.89e	2.75b	1.90b
Zeolite 50%	0.649c	0.928c	0.314c	0.519d	5.78e	9.78d	3.27a	2.07a
Zeolite 100%	0.847b	1.498b	0.343c	0.558d	6.46d	10.51c	3.38a	2.05a
Magnetite 50% + Bio	0.692c	1.065b	0.403b	0.538d	6.47d	10.12c	3.17a	2.09a
Magnetite 100% + Bio	0.734c	1.159b	0.446b	0.596d	7.53c	10.63c	3.28a	2.02a
Zeolite 50% + Bio	0.850b	1.719b	0.462b	0.637c	7.47c	11.18b	3.27a	2.10a
Zeolite 100% + Bio	0.855b	1.831b	0.503a	0.695c	7.58c	11.24b	3.28a	2.07a
Magnetite 50% + Zeolite 50%+ Bio	1.216a	2.169a	0.520a	0.746b	8.73b	12.85a	3.44a	2.23a
Magnetite 100% + Zeolite 100%+ Bio	1.738a	2.241a	0.524a	0.835a	9.85a	12.94a	3.56a	2.30a

Means with the same letter in a column are not significantly different by DMRT at level 5%

Increased in total carbohydrates and photosynthetic pigments in mixture treatment as compared to control may be due that many biotic and abiotic factors are influencing the production of isoprenoid substrates for carotenogenesis Mahmoud and Swaefy (2020). In addition, mixture treatment caused a considerable change in the soil pH and that would have a significant increase in macronutrients availability (N, K, Mg, P and Ca) to plant roots, increased their uptake which increased the number of chloroplast per cell as well as photosynthetic efficiency and increased sugar content in plants Mahmoud and Swaefy (2020).

Moreover increment in total carbohydrate and total phenolic may be due to the increase of photosynthesis as a result of increase in photosynthetic pigments content in leaves, also could be refer to the fact that zeolite with cages structure together with a depiction of the straight and zigzag channel appears to be a source of water retention and number of essential elements that may play an important role in plant metabolism, conspicuously the most significant function would appear to involve carbohydrate metabolism and photosynthesis and drought resistance as aftereffect Tisdale and Nelson, (1975). On the ground of previous data, all the secondary metabolites may not enhance in the same ratio in reaction to water stress since plants show uneven or changeable response to drought stress for different secondary products. Mahmoud and Swaefy (2020).

4. Conclusion

On the ground of previously mentioned results, which lead to the conclusion that application of (Magnetite 100% + Zeolite 100%+ Biofertilizers) gave eminent outcomes on either plant under study *Oenothera biennis* plant and environment represented in higher growth characteristics and chemical composition in contrast to results derived from commercial recommended dose of chemical fertilizers NPK taking into account both quality and quantity parameters particularly with medicinal and aromatic plants, unthinking or regardless economic factor since such plants are considered infrastructure of pharmaceutical, cosmetics industries and a source of national income, in addition to decreasing environmental pollution mainly in newly reclaimed areas.

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