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Effect of Electromagnetic (Non-Ionizing Radiation) Waves on Germination and Some of Productivity Traits for Bread Wheat (Adana 99)

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ABSTRACT

Pollution by electromagnetic waves has become like other pollutants, especially with the increase in the number of communication towers as a result of technical progress and the development of communication networks. The seeds were treated with electromagnetic waves at the following distances (0,10,30,50 cm) and for a period of (0,15,30,60 min).

The experiment recorded a significant decrease in the traits of spike weight and spike length with different distances from the source of electromagnetic waves, while the effect of distances was not significant on the rest of the traits. The exposure periods also recorded a significant decrease in plant height (cm), plant dry weight (gm) and spike length (cm). The number of grains/spike and the weight of 10 spikes (g). While the exposure periods were not significant with the trait of germination percentage and spike weight. The interaction between periods of exposure to electromagnetic waves × distances was also recorded as significant change between the zero distance × all exposure periods for all traits except for the percentage of germination and significant interaction between the distance 10 × all exposure periods for the traits of the weight of the spike and the number of grains / spike, and the interaction was also significant between the distance 30 × all periods of exposure to the characteristic of the dry weight of the plant and the weight of the spike (g) and the number of grains / spike, as well as the significant interaction between the distance 50 × all exposure periods for the characteristic of the number of seeds grains/spike and weight 10 spikes. the electromagnetic waves did not kill the wheat seeds, but left negative effects on the production elements of wheat and that the amount of damage depends on the exposure period and the distance from the source of the waves.

Keywords- electromagnetic waves, productivity traits, oxidative stress, effect, wheat

I. INTRODUCTION

As a result of the increasing use of mobile technology, communication towers surrounded us from every side. As the number of communication towers in the city of Mosul reached high numbers, it was noted that the levels of radiation power density for Asiacell Company are higher than that of Korek Company, as well as the levels of radiation power density on the left side are higher than on the right side Because it is more numerous, widespread and randomly distributed (al-tamer, 2020), and this in turn increases the pollution by electromagnetic waves, which affects not only humans, but also extends to other organisms such as plants as well.

Most studies have indicated the negative effects of electromagnetic waves on plants, such as germination reduction, root length, vegetative length, and changes at the molecular, cellular and biochemical levels (Betskii et al. 2007; Poghosyan and Mukhaelyan 2018). Inhibition of Brassica plant growth and root growth reduction was observed after exposure to electromagnetic waves emitted from mobile devices as a result of increasing reactive oxygen species (ROS) and exposure to electromagnetic waves enhanced the oxidation of fats and increased the accumulation of hydrogen peroxide H2O2 all due to oxidative stress. The increase in the level of Scavenging Enzyme, however, did not prevent radiation damage to Harminder and vedprakash (2011). The researchers also noticed a decrease in the root length of the lentil lens culinaris Medika when electromagnetic waves with a wavelength of 1800MHz were applied, and the frequencies were more effective in the dormancy stage of the seeds compared to the germination stage. The study also recorded an increase in the c-mitoss phase, especially in the stage of seed latency when studying the mitosis at the top of the roots of lentils. The same source mentioned that the effect of electromagnetic waves on the plant makes the plant inedible. We must not neglect the effect of these waves on living cells (Akbal, 2012).

Another study on seedlings of grain (vigna radiate) and wheat (Triticum aestivum) seedlings indicated that the exposure of the previous seedlings to electromagnetic waves caused morphological and biochemical changes whereby the growth of wheat and radish seedlings, fresh and dry weight and water content were increased. Stressed compared to non-stressed seedlings and concluded that mobile phone can cause oxidative stress, which leads to reduced growth and increased activity of antioxidant enzymes in bean and wheat seedlings (Afsal and Mansoor, 2012). , 4.6 h led to a reduction in germination, shoot length, root system and leaf area, while the fresh and dry weight of lettuce seedlings increased, and the concentration of flavonoids

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increased with the increase in the period of exposure to electromagnetic waves, where flavonoids are considered as antioxidants that increase when the plant is exposed to oxidative stress (Sharma and leena, 2016). One study, when applying electromagnetic waves to pepper plant (Capsicum annuum L.) papper during seed germination and seedling stage, found that exposing the seeds to frequencies of 2.450 mh2 for 10 hours led to a high percentage of germination (SGP)). And that the long exposure periods changed the behavior of the leaves, and the exposure of seedlings for 1 hour increased the height of the plant and the number of leaves. The sources mentioned that it is possible to apply electromagnetic waves to produce mutant plants in plant breeding programs (Mohsenkhah et.al, 2018) and the magnetic field fluctuations resulting from Atmospheric events influence the growth and development of plants and the interactions of plants with other environmental factors. In his experiment, he used 14-16-day-old wheat seedlings of the cultivar (Daria). The researchers concluded that the magnetic field with a low frequency of 14.3 Hz modifies the electrical interactions induced by light. The flux was recorded in Calcium ions through the plasma membrane as a mechanism for the influence of the magnetic field on the electrical interaction caused by light (Grimberg et al., 2022). Electromagnetic, especially from stations and communication towers near wheat fields. The aim of the current research was to detect the harmful effects of these waves on one of the field crops cultivated in Iraq, which is the wheat variety Adana 99 .

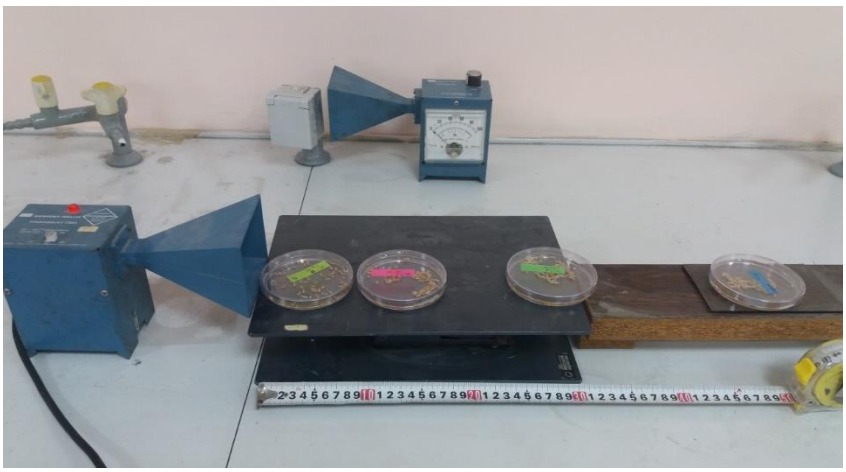
II. MATERIALS AND METHODS

Wheat seeds adana 99 (It is one of the Turkish varieties recently introduced to Iraq) were obtained from the Department of Field Crops/College of Agriculture and Forestry/Mosul University and the experiment was applied in the wire canopy of the above department during the academic year 2019-2020. For each treatment, it was then soaked in water and exposed to an electromagnetic wave device (German origin from Sargat Welch company, a horn microwave antenna at a frequency of 10 GHz within the x-band band obtained from the Department of Physics/Faculty of Science) and at the following distances (0,10,30,50 cm).) for a period of (0,15,30,60 min) for each distance, which is equivalent to (90,80,39,22 watts), as shown in the picture No. (1). It was observed that water droplets adhered to the upper surface of the petri dish during exposure to waves as evidence of the passage of electromagnetic waves through the dishes After completing the irradiation process, the seeds were transferred to two anvils the size of (15 liters) and three replicates, ie (3×16) experimental units.

The experiment was designed with a completely random design as a factorial experiment with two factors, the first is the distance (after the ptridish is applied to the source of the electromagnetic waves) (0,10,30,50 cm) and the second is the exposure time (0,15,30,60) and the experiment was applied with three replications so that the number of experimental units was 48 An experimental unit and the anvils were then left for atmospheric conditions. Then the following measurements were taken on the treated plants:

1- The percentage of germination in the field after 15 days and after the maturity of the plants, some of productivity traits were taken:
2- Plant height after harvest (cm)
3- Dry weight of the whole plant (gm)
4- spike weight (g)
5- spike length (cm)
6- Number of grains / spikes
7- Weight of 10 spikes (gm)

Data analysis was performed according to the global experience system by designing the complete random [17]. Moreover, the Duncan test was used to compare averages at P-value < 0.05[18]. The analysis was conducted according to the statistical program SAS[19].



Picture No. (1) shows the process of seed irradiation with an electromagnetic wave device and the adhesion of water droplets to the upper surface of ptridish dishes as a result of exposure to electromagnetic waves

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III. RESULTS AND DISCUSSION

Table No. (1) shows the effect of distances (distances from the source of electromagnetic waves) on some yield characteristics of bread wheat.

Weight of 10 spikes (gm)	Number of grains/spike	spike length (cm)	spike weight (gm)	Plant Dry Weight (gm)	Plant height	germination percentage	Distances(CM)
2.76a	8.75a	4.34a	0.26ab	0.73a	38.67a	6.92a	0
2. 34a	8.62a	3.59b	0.26ab	0.71a	37.62a	7.58a	10
2. 65a	7.75a	3.42b	0.35a	0.69a	36.88a	8.25a	30
2.48a	8.07a	3.63b	0.20b	0.68a	35.71a	8.92a	50

Different letters show the significant differences at p 0.05 according to Duncan test Multi-range at each characteristic.

The results of Table (1) show the effect of distances on some productivity characteristics of bread wheat Adana 99, where a significant change was recorded at the probability level of 0.05 in the weight and length of the spike, which is considered one of the important production elements. The weight and length of the spike may be due to the negative effect of electromagnetic waves on the seeds after being exposed to radiation and causing them to oxidative stress, which damaged the production elements such as the weight and length of the spike. Also, exposure to electromagnetic waves has enhanced fat oxidation and increased hydrogen peroxide H_2O_2 accumulation due to oxidative stress. As found by Akbal (2012).

In his study of lentil plant growth, however, electromagnetic waves affected the lentil plant in the seed latency stage more than the germination stage, and the length of the roots decreased as a result of oxidative stress, and an increase in the c-mitosis phase was recorded, especially during the seed latency stage. And El-maghraby (2014) in his research when evaluating the effect of radiation emitted from two types of mobile phones in two cases (talk) and (non-speaking) on the germination rate and embryonic stem length of wheat seeds after varying periods of exposure (5, 10, 15, 20 and , 25 and 30) and different distances from the mobile 5 cm, 10 cm, 15 cm. It was found that exposure to cell phone radiation has a depressing effect on the germination rate and embryonic root length of wheat seeds. As for the rest of the characteristics: germination percentage, plant height, plant dry weight (g), number of grains on a spike and weight of 10 spikes were lost. The effect of distance was not significant on her.

Although the effect of distance was not significant on the percentage of germination, it was observed that the seeds stimulated germination after treatment with electromagnetic waves, where the table recorded an increase in the percentage of germination for all distances compared to the distance zero, but it is a non-significant increase and this result is consistent with what was observed by the researcher Mohsenhah et al, 2018 when exposing the seeds of a plant pepper (Capsicum annuum L.) by microwave has increased the germination rate and the reason was attributed to the increase in the temperature around the seeds, which facilitated and helped stimulate growth and increase germination.

Table No. (2) shows the effect of periods of exposure to electromagnetic waves on the yield characteristics of bread wheat adana 99.

Weight of 10 spikes (gm	Number of grains/spike	spike length (cm)	spike weight (gm)	Plant Dry Weight (gm)	Plant height	germination percentage	exposure time
3.22a	11.63a	4.63a	0.30a	0.84a	40.31a	6.83a	0
2.39b	7.30b	3.57b	0.22a	0.62b	36.52ab	7.67a	15
2.35b	7.22b	3.73b	0.23a	0.69ab	38.29ab	8.83a	30
2.29b	7.04b	3.25b	0.32a	0.66ab	33.74b	8.33a	50

Different letters show the significant differences at p 0.05 according to Duncan test Multi-range at each characteristic.

The results of Table (2) show the effect of periods of exposure to electromagnetic waves on plant height, plant dry weight (g), spike length (cm), number of grains / spikes, and weight of 10 spikes (gm). The above table recorded the lowest height of wheat plant by 33.74b at the exposure period 60 and at the probability level of 0.05 that the decrease in plant height, dry weight of the plant and weight of 10 spikes (gm). (vigna radiate) and wheat (Triticum aestivum) seedlings after exposure to electromagnetic waves, where they observed

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a decrease in growth, fresh and dry weight, water content, and an increase in the content of melonddialdehayde (MDA) and antioxidant enzymes in stressed seedlings compared to non-stressed seedlings, and they concluded that mobile phone can cause oxidative stress, which It leads to reduced growth and increased activity of antioxidant enzymes in bean and wheat seedlings. Other researchers also mentioned that electromagnetic waves cause changes in the level of plant antioxidants and free radicals in rice and wheat plants (Seo et al., 2016; Mukhaelyan et al, 2016; Mukhaelyan and emiehf, 2017).

As for the decrease in the length of the spike and the number of grains/spike, this may be due to the effect of oxidative stress caused by electromagnetic waves on the division in the plant. It was mentioned (Akbal, 2012) in his study of the lentil plant lens culinaris medika that the electromagnetic waves have increased the formation of c-mitosis and he attributed the reason for the increase To a problem in the function of the spindle filaments, as he mentioned that electromagnetic waves make the plant inedible, and we must not neglect the effect of these waves on living cells.

Also, the reduction of the weight of 10 spikes may be due to the reduction of carbohydrates and the lack of starch formation, as kumar (2015) noted inhibition by carbohydrates and a disturbance in the starch formation pathway, which led to a reduction in the growth of maize seedlings.

Table (3) shows the effect of interference between distances and periods of exposure to electromagnetic waves on some yield characteristics of bread wheat, adana 99.

Weight of 10 spikes (gm)	Number of grains/spike	spike length (cm)	spike weight (gm)	Plant Dry Weight (gm)	Plant height	germination percentage	exposure time	Distances(CM)
4.00a	12.16a	6.74a	0.35ab	1.02a	44.87a	4.33a	0	0
2.53b	7.70b	3.82b	0.20b	0.56b	34.97ab	6.67a	15	
2.36b	7.16b	4.05b	0.23b	0.66ab	39.100ab	7.67a	30	
2.17b	7.96b	3.53b	0.27ab	0.70ab	35.70ab	7.67a	60	
2.77b	11.86a	3.85b	0.29ab	0.88ab	38.43ab	7.33a	0	10
2.30b	8.16b	3.58b	0.26ab	0.71ab	40.03ab	7.00a	15	
2.23b	7.40b	3.67b	0.25b	0.64ab	37.80ab	9.00a	30	
2.07b	7.06b	3.25b	0.24b	0.60ab	34.20ab	7.00a	60	
2.90b	11.33a	3.65b	0.38ab	0.58b	41.03ab	9.67a	0	30
2.67b	6.33b	3.20b	0.22b	0.22b	35.80ab	7.33a	15	
2.27b	7.33b	3.77b	0.24b	0.24b	38.70ab	6.67a	30	
2.80b	6.00b	3.07b	0.54a	0.54a	31.97b	10.00a	60	
3.20ab	11.16a	4.27b	0.19b	0.19b	36.90ab	9.00a	0	50
2.07b	7.00b	3068b	0.19b	0.19b	35.27ab	10.00a	15	
2.53b	7.00b	3.45b	0.19b	0.19b	37.57ab	9.00a	30	
2.13b	7.13b	3.13b	0.22b	0.22b	33.10ab	9.00a	60	

Different letters show the significant differences at p 0.05 according to Duncan test Multi-range at each characteristic.

Table (3) also shows the interference between distances and periods of exposure to electromagnetic waves, where the above table recorded a significant interference at a probability level of 0.05 There was a significant interaction between the distance zero × all exposure periods for all traits except for the percentage of germination, as the same table recorded a significant interaction between the distance 10 × all exposure periods for the characteristic of spike weight and the number of grains/spike. G) and the number of grains/spike, as well as the significant interaction between the distance 50 x all exposure periods for the characteristic of the number of grains/spike and weight of 10 spikes. Electromagnetic waves (non-ionizing) such as waves emanating from towers and mobile devices cause physiological, biochemical and molecular changes in plants exposed to them, and all of these changes depend On the dose and duration (exposure period), one of the researchers mentioned that the exposure of wheat seeds to waves emitted from the mobile phone for periods (5,10,15,20,25and 30)min and distances of 5 cm, 10 cm and 15 cm had a dampening effect on the germination rate and the length of the embryonic root of wheat seeds, which is reflected Later on wheat productivity and crop quality (Hussein and maghraby, 2014.

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Also, the exposure of corn seeds to electromagnetic waves with wavelength 945mh recorded a change in the content of melonddialdehayde (MDA) after 3 hours of exposure, and that the high content of (MDA) was an indicator of the oxidation of fats in the leaves. Change the percentage of germination and hadrogen peroxidase (H2O2) after exposure period 48 hours (zare et al, 2015).

IV. CONCLUSIONS

I concluded from my experience that the electromagnetic waves did not kill the wheat seeds, but left negative effects on the production elements of the wheat and that the amount of damage depends on the exposure period and the distance from the source of the waves.

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