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STUDY OF EFFECT OF MAGNETIZED WATER ON GROWTH OF WHEAT (*TRITICUM VULGARE* LINN.)

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Abstract: Water is the most important element for all the metabolic activities of a plant body occupying major part of the weight in a living plant. All the plants contain water inside them in the form of a sap which is an electrical conductor. Plants need nutrient elements from the soil to function and photosynthesize properly. However, plants do not use the majority of nutrients that are in soil. With normal water, only a small amount of nutrient elements dissolve in the soil and are available to the plants. Deficit of these elements results in low productivity of the crop. The deficit of nutrients in the soil is the main reason for a decreased growth rate, quantity and quality of the crop. It has been recently studied that magnetized water has a positive effect on plants to enhance their growth and development to improve the crop in terms of quantity and quality. That is the reason why magnetized water should be used for irrigation. In the present studies, effect of magnetized water was tested on Wheat (*Triticum vulgare* Linn.) by exposing the plants to magnetized water for a period of 14 days. The differences between treated and untreated plants were estimated in terms of morphological changes such as shoot length and biochemical tests viz. estimation of chlorophyll, carbohydrates, proteins, nucleic acids such as DNA, RNA etc. by using spectrophotometric analysis. The results were analyzed to study the differences.

Key Words: Magnetized Water, Growth & Development, Spectrophotometric Analysis

INTRODUCTION

In recent years, substantial progress is done in the field of magnetic microspheres, magnetic nanospheres and magnetic fluids regarding their applications in the biological systems. Techniques based on using magnetizable solid phase support various biological fields such as diagnostics, drug targeting, molecular biology, cell isolation and purification (Safarikova and Safarik, 2001). Studies on *Mammilaria duwei* cultivated in culture medium supplemented with magnetic fluids showed increased metabolic activities in living tissues (Corneanu *et al.,* 1995).

Magnetic fluid stimulates the plant metabolism in graminaceous plants due to efficient mechanism of iron acquisition (Crowley, 1991). Water and life are linked very closely. Liquid water is essential to start and continue life on the earth as the key factor (Trevors and Pollack, 2005). It has been found that physical and chemical properties of water are changed when it is magnetized. N. Hirota *et al.,* (1999) studied the effect of non-uniform magnetic field on germination of plants. M. Mathur and Le Zhang (2003) reported effect of static electromagnetic field on the root hairs of radish. Exposure of the seeds to the magnetic field for a short time was found to help in accelerating sprouting and growth of the seedlings (Carbonell *et al.,* 2000). It has been also studied that magnetic field treatment of seeds leads to acceleration of plant growth, protein biosynthesis and root development (Chao and Walker, 1967).

Considering the importance of photosynthesis, for biosphere and the earth along with omnipresence of iron and its compounds in the environment, new research projects focused on the effect of magnetic fluids on plants are needed to be taken up. Hence, in the present studies effect of magnetized water on growth of Wheat (*Triticum vulgare* Linn.) was studied in terms of morphological parameters such as germination percentage, root length, shoot length etc. and biochemical parameters such as estimation of chlorophyll, Proteins, reducing sugars etc.

MATERIALS AND METHODS

The experiments were carried out in two steps as Cultivation of the plants and detection of morphological and biochemical parameters.

Step 1: Cultivation of the plants

i. Samples of wheat grains collected from provisional stores were soaked in regular tap water for 16 hours and then used for sowing.
ii. Two pots of medium sized were filled with the garden soil and the soaked wheat grains were sowed in them @ 100 grains in each pot.
iii. One pot was watered with regular tap water while the other pot was watered with magnetized water. The water was magnetized by using a round magnet of 0.50 T.
iv. The process was continued for consecutive 14 days and then the results were recorded.

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Step 2: Detection of morphological parameters biochemical parameters

(A) *Morphological Parameters:*

i. Percentage germination of seeds was calculated by counting number of seeds germinating out of 100 seeds in each pot, watered with regular tap water and magnetized water.
ii. Shoot length of each germinated plantlet was noted down and average was calculated.
iii. Fresh weight of each germinated plantlet was noted down and average was calculated.

(B) *Biochemical Parameters:*

Detection of Chlorophyll: To estimate chlorophyll (Holden 1965) from healthy and infected grains of jowar, 100 seeds of jowar were sown in a container with soil. One container was kept as a control while remaining 12 containers were inoculated with 10 ml of spore suspension of the isolated fungal pathogens separately. The seeds were allowed to germinate for 7 days and then 1 gm of fresh leaves were collected from each container to estimate the chlorophyll contents of the samples. Same procedure was followed for bajra seeds. 1 gm leaves of healthy and infected seedlings of jowar and bajra were weighed separately and each sample was soaked in 10 ml 80% acetone. The material was crushed in mortar with the help of pestle by addition of a pinch of $MgCO_3$ to avoid denaturation of the chlorophyll. The mixture was homogenized and filtered through Whatman No. 1 filter paper. The filtrate was collected and diluted to 25 ml by adding 80% acetone. The absorbance was noted down at 625 nm. Total chlorophyll content was calculated in terms of chlorophyll (mg / ml) by using the formula:

Total chlorophyll = Absorbance at 625 nm x 5.8 (multiplication factor)

Detection of Reducing Sugars: Quantitative estimation of reducing sugars was carried out by using anthrone reagent method (Dubois *et al., 1951*). For extraction of reducing sugars from the grains, 1 gm of seed sample was ground with 10 ml 80% alcohol to get a homogenized mixture. The total volume of the homogenate was made to 20 ml by adding 80% alcohol. The mixture was then centrifuged at 5000 rpm for 10 minutes. The supernatant was collected.

1ml of supernatant was taken separately in a test tube and heated on a water bath till no smell of alcohol. Distilled water was added to this extract to make the volume 2 ml. To this solution, 4 ml anthrone reagent (0.2 gm anthrone reagent dissolved in 100 ml concentrated sulphuric acid) was added carefully, drop by drop from the side of the test tube. Blank was prepared in the same manner by using distilled water. The procedure was performed for healthy and infected grains of jowar and bajra. All the test tube were covered to avoid loss by evaporation and kept in boiling water bath at 100 ^oC for 10 minutes. The test tubes were cooled to room temperature and absorbance was measured at 625 nm. The amount of sugar was calculated by using standard graph of glucose.

Detection of Proteins: Quantitative estimation of proteins in healthy and infected grains of jowar and bajra was carried out by Lowery's method (1951). The method was divided into 2 parts as extraction of proteins from the seed samples and estimation of proteins from the extract. For extraction of proteins, 1 gm of seed sample was soaked in 80% alcohol for 10 minutes and then crushed in hot 80% alcohol to get homogenized mixture. The mixture was centrifuged at 2000 rpm for 10 minutes. The precipitate was collected and 10 ml chilled 5% TCA was added to it and extraction was carried out for 15 minutes at 0 ^oC in an ice bath. 1 ml of this extract was taken in a separate centrifuge tube and 1 ml of 10% perchloric acid was added to it. The proteins were precipitated. The test tubes were allowed to stand for 15 minutes at 0 ^oC and then the extract was centrifuged at 2000 rpm for 10 minutes. The residue was collected and re-extracted with 10 ml mixture of alcohol and ether in a ratio of 1:1 v/v. The mixture was centrifuged at 2000 rpm for 10 minutes. The precipitate was collected which was consisting the proteins to be estimated. The protein residue was mixed with 1 ml 1 N NaOH and test tubes were kept in boiling water bath at 100 ^oC for 5 minutes. The test tubes were cooled at room temperature. 5 ml of reagent C was added in each test tube and allowed to stand for 15 minutes. 0.5 ml Folin – Ciocalteu reagent was added to each test tube and again allowed to stand for 15 minutes. The absorbance was read at 730 nm.

Detection of Phytosterols: Lipids in the seeds in the form of phytosterols were estimated by modification of method given by Tomita *et al., (*1970). In this method, 1 gm seeds were crushed in 10 ml 80% alcohol and the mixture was warmed slightly. The homogenate was allowed to cool for 10 minutes and filtered through Whatman No. 1 filter paper. The filtrate was collected and used for estimation of phytosterols. 0.5 ml of the extract was taken in a test tube and 2ml glacial acetic acid and 2 ml coloured reagent were added to it. The total volume was adjusted to 5 ml by adding 80% alcohol in it. The test tubes were incubated in an ice bath at 0 °C for 10 minutes and absorbance was read at 440 nm. The values for healthy and infected seeds of jowar and bajra were calculated by using 0.1 as the multiplication factor.

Estimation of Nucleic Acids: For extraction of nucleic acids, 1 gm of healthy and infected seeds of

jowar and bajra were heated in 10 ml 80% alcohol and homogenised with the same alcohol in a mortar and pestle. The homogenate was centrifuged at 2000 rpm for 20 minutes.

The residue was extracted with 5% chilled Trichloro Acetic Acid (TCA) for 15 minutes to dissolve it. 1 ml from this extract was taken separately and 1 ml chilled 10% Trichloro Acetic Acid (TCA) was added to it and incubated at 0°C for 15 minutes. The mixture was centrifuged at 2000 rpm for 20 minutes and residue was collected. The residue was dissolved in 3 ml absolute alcohol and subjected to centrifugation at 2000 rpm for 20 minutes. The supernatant was discarded and residue was extracted with 3 ml mixture of alcohol and ether in ratio of 3:1. The mixture was centrifuged again at 2000 rpm for 20 minutes. The pellets were collected and dissolved in 3 ml 0.3 N Potassium Hydroxide (KOH) and incubated at 37 °C for 18 hours. After incubation, the mixture was centrifuged at 2000 rpm for 20 minutes and supernatant was collected. A drop of hydrogen perchlorate was added to the extract. The DNA was precipitated as residue while the RNA remained in the extract. The mixture was again centrifuged at 2000 rpm for 20 minutes to collect DNA as precipitate and RNA in the form of supernatant (Mahadevan and Sridhar, 1984).

Estimation of DNA was carried out by method given by Burton (1968). 0.9 ml 5% Trichloro Acetic Acid (TCA) was added as a diluent to 0.1 ml seed extract. 2 ml of diphenyl amine indicator (1 gm diphenyl amine dissolved in 98 ml glacial acetic acid and 2 ml concentrated sulphuric acid). The test tubes were covered and the mixture was boiled for 20 minutes at 100 °C in a water bath. The test tubes were cooled and absorbance was noted down at 660 nm.

Estimation of RNA was carried out by method given by Markham (1955). 0.2 ml seed extract was taken in a test tube and 2 ml orcinol reagent was added to it. The test tubes were covered and heated in boiling water bath at 100 °C for 8 minutes. The test tubes were cooled down to room temperature and absorbance was recorded at 665 nm.

RESULTS AND DISCUSSION

A shown in Table 1, percentage of germination of wheat grains in case of normal water was 29.41% while in case of magnetized water it was 42.35%, which was 12.94% more than normal water. In case of shoot length, wheat grains sprinkled with normal water showed average shoot length was 23.25 cms while the grains sprinkled with magnetized water showed average shoot length of 36.89 cms. Hence, difference between the two categories was 13.64 cms.

Table 1: Percentage of germination of wheat grains

S.No.	Parameters	Category	
		Normal Water	Magnetized Water
1	Percentage Germination	29.41	42.35
2	Shoot Length (cms)	23.25	36.89
3	Chlorophyll Estimation (mg / Gram)	4.29	6.29
4	Reducing Sugar Estimation (mg / Gram)	0.84	1.26
5	Protein Estimation (mg / Gram)	0.08	0.34
6	Phytosterols (mg / Gram)	0.03	0.11
7	Deoxyribose Nucleic Acid (DNA) (mg / Gram)	0.80	0.95
8	Ribose Nucleic Acid (RNA) (mg / Gram)	2.25	3.35

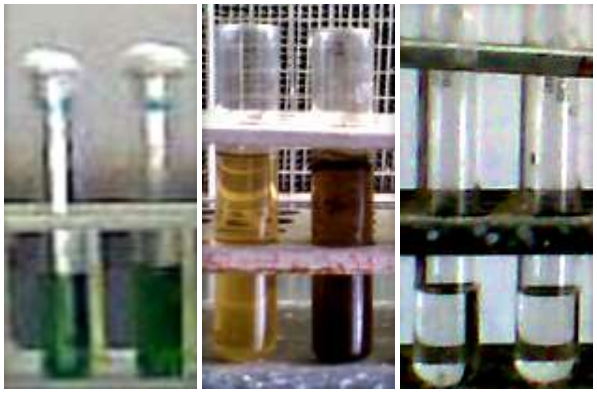
Estimation of chlorophyll in case of wheat grains grown with normal water showed that it was 4.29 mg per gram and in case of grains grown with magnetized water showed that it was 6.29 mg per gram.

In case of reducing sugar, wheat grains in normal water showed 0.84 mg of reducing sugar per gram and wheat grains in magnetized water showed 1.26 mg of reducing per gram. The amount of protein in grains sprinkled with normal water was estimated to be 0.08 mg per gram and grains sprinkled with magnetized water was estimated to be 0.34 mg per gram.

The amount of physterols estimated in the wheat grains germinated in normal water was 0.03 mg per gram while in case of magnetized water it was 0.11 mg per gram. The wheat grains germinated with normal water showed presence of 0.80 mg and 2.25 mg of DNA and RNA respectively while the grains sprinkled with normal water showed presence of 0.95 and 3.35 mg of DNA and RNA respectively.

Hence, in case of all the parameters, it was seen that the wheat grains grown in magnetized water showed higher and better results than the wheat grains grown in normal tap water. As a result, magnetized water enhanced growth and development of wheat grains as compared to normal tap water.

Normal Seedling **Abnormal Seedling** **Non Germinated Seed**



A B C

A: Estimation of Chlorophyll
B: Estimation of Reducing Sugars
C: Estimation of Protein

CONCLUSION

It has been concluded from the present studies that magnetized water has positive effect on the growth of wheat (*Triticum vulgare* Linn.) as far as morphological and biochemical parameters are concerned. Hence, use of magnetized water can be suggested as one of the remedies for wheat crop to enhance the quality as well as quantity of the crop instead of using chemical fertilizers. Similarly, it can be implemented for the other crops as well. There is a need of lot of research work in this field and with concrete solutions it can be implemented in developing country like India where still 65% population is dependent upon agriculture for their livelihood.

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