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Influence of magnetized irrigation water and fertilizer doses on physical properties of soil in brinjal crop field

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Abstract
The experiment was carried out at Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram in split plot design during the year 2020-2021 to study the impact of irrigation scheduling based on IW/CPE ratio with normal and magnetized water, and different doses of fertilizes on soil texture and bulk density in main and ratoon crop of brinjal. Main plot treatment consisted of irrigation scheduling of normal and magnetized water based on IW/CPE ratio, and subplot treatment consisted of different doses of fertilizes. Results of this study indicated that there was no significant change soil texture and bulk density of the soil for both the main and ratoon brinjal crop.

Keywords: Magnetized water, fertilizer doses, soil texture, bulk density, brinjal, main and ratoon crop

Introduction
In recent years the magnetization of water and its application in agriculture is grabbing the researcher's attention because of its novelty, environment friendly and beneficial effect on plant growth and development (Surendran *et al*. 2016) [11]. When water is passing through a magnetic field, it become magnetized water (MW) and this process is known as magnetization of water. When water is exposed to a magnetic field, there will be an alteration in the physical characteristics of the water resulting in a favourable influences in agriculture. Water's ability to retain magnetic energy was dependent on saturation capacity and magnetic memory (Chibowski *et al*., 2004) [6]. Application of magnetic water to crops influence the growth and development of crop as well as changes various soil physio-chemical properties (Al-Ghamdi, 2014) [1]. Very few researchers have worked on the impact of magnetic water on soil physical properties. Fertilizers are usually applied to soil for increasing the crop yields so as to meet the increasing demand of food. Application of inorganic fertilizers results in an increase of soil organic matter content and biological activity in soil due to increased plant biomass production and organic matter returns to soil in the form of decaying roots, litter and crop residues (Reddy *et al*. 2017) [10]. Soil texture and bulk density are basic soil properties influenced by some soil physical and chemical properties (Chaudhari *et al*. 2013) [5]. According to Cliek *et al.* (2010) [4], soil texture and bulk density are important indicators of soil compaction because it changes the air–soil and water–soil interactions, which influence microbiological activity, nutrient uptake, and water retention. This is a recent technique, attempted to study the effect of irrigation scheduling with magnetic and normal water and different doses of fertilizers on soil physical properties. Knowledge of soil texture and soil bulk density are essential for soil management, and information about it is important for planning modern farming techniques.

Materials and Methods
This experiment was carried out at Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India during the year 2020-2021 to study the impact of scheduling of magnetized irrigation water and different doses of fertilizes on soil texture and bulk density in the main and ratoon crop of brinjal. The experiment was laid out in split plot design with four replications, assigning 12 treatments consisting of irrigation scheduling based on IW/CPE ratio *ie* I_1: irrigation at IW/CPE ratio 0.6 with normal water; I_2: Irrigation at IW/CPE ratio 0.8 with normal water; I_3: Irrigation at IW/CPE ratio 0.6 with magnetized water and I_4: Irrigation at IW/CPE ratio 0.8 with magnetized water as main plot treatment, and three different doses of fertilizer *ie* F_1: 50% Recommended dose of fertilizer; F_2: 75% Recommended dose of fertilizer and F_3:100% Recommended dose of fertilizer as subplot treatment.

30 days old brinjal variety "Haritha" was transplanted at a spacing of 75 cm X 60 cm in the *summer* season of 2020 and grown for five months as main crop and the same crop was pruned six months after harvesting to a height of 30cm from the soil surface to get a ratoon crop which was again maintained for five months as *rabi* crop in 2021. Both the crops *i.e.* main and ratoon crop were irrigated to a depth of 40mm according to the irrigation scheduling treatments with normal and magnetized water. Urea, rajaphos, and MOP were applied at a rate of 75:40:25 $N:P_2O_5:K_2O$ kg ha^{-1} as per POP recommendations of Kerala Agricultural University (KAU, 2016)[8]. Initial soil sample and the soil after harvesting of each crop, was collected and analysed for physical properties like sand, silt and clay using Bouyoucos hydrometer method (Bouyoucos, 1962) [3] and the buld density was assessed and expressed in g cm^{-3} (Gupta and Dakshinamoorthy, 1980) [7]

Two tanks (Tanks A and B) of 60 litres capacity were installed to magnetize water and are linked to a single valve using PVC pipes. The bar magnets of strength 1000 G and 2000 G were placed on PVC pipes connected to the tank A and B respectively as shown in Plate 1. A half-HP motor with a discharge rate of 84 litres was installed for water circulation. The circulation of water in the tanks is regulated by the opening and closing valves fitted on the PVC pipes. The magnetization of the water is maintained by passing the water through the area enclosed by the magnets repeatedly for around 15 minutes.

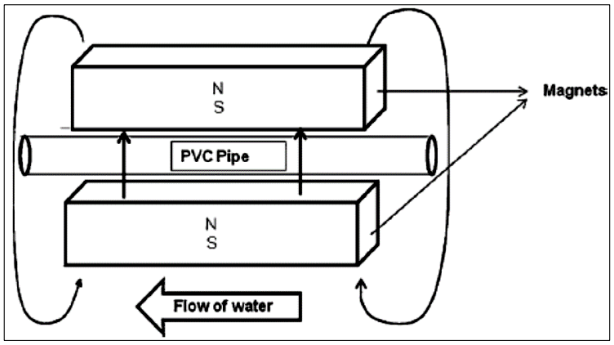

Plate 1: Schematic diagram of magnets arrangement and direction of magnetic field generation

Results and Discussion

The treatments irrigation scheduling based on IW/CPE ratio with normal and magnetized water and different fertilizer doses and their interactions could not significantly influence the soil texture and bulk density of the soil. The soil of the experiment belongs to the textural class sandy clay loam both before and after the experiment. The data pertaining to the results of the initial soil sample (Table. 1) and final soil sample after the harvest of the crop (Table. 2) revealed that the soil belongs to the textural class sandy clay loam. The initial soil was having 65.52 per cent sand**,** 11.30 per cent silt and 22.18 per cent clay and the soil from different treatments after the final harvest of the crop was having sand content ranging from 63.11 to 66.03 per cent, clay from 23.41 to 24.93 per cent and silt ranging from 10.53 to 12.17 per cent in main crop, and in ratoon crop, the content of sand ranged from 62.99 to 66.06 per cent, clay 22.87 to 26.98 per cent, and silt 8.58 to 12.36 per cent. From the results of the experiment it is seen that both magnetisation of water and irrigation water scheduling based on IW/CPE ratio could not alter the texture of the soil. Tunio *et al.* (2020) [12] also reported that irrigation scheduling had no significant influence on sand, silt and clay content of soil. The initial bulk density of the soil was 1.46 g cm^{-3} and the from soil taken from different treatments after the final harvest of the crop, it ranged from 1.28 to 1.33 g cm^{-3} in main crop and from 1.32 to 1.36 g cm^{-3} in ratoon crop. Even though not significant, both in main crop and ratoon crop, the final bulk density of soil was decreased compared with initial soil sample in all the treatments. A higher bulk density was recorded in irrigation at IW/CPE ratio of 0.6 and the lower bulk density was recorded in IW/CPE ratio of 0.8 with magnetized water in both the crops. When compared to normal water, magnetized water recorded much lower bulk density for both main crop and ratoon crop. This is in line with finding of Anon. (2000) [2] who reported that magnetized water works to reduce bulk density in saline soil by dissolving and washing the salt thereby preventing its accumulation in soil. Rahimi *et al*. (2017) [9] also reported that the magnetic water and different levels of salinity did not have a significant effect on bulk density of soil.

Different doses of fertilizers had no significant influence on the sand, silt, and clay content as well as bulk density of soil and it belongs to the textural class sandy clay loam both before and after the experiment. The final soil collected from the treatments having different doses of fertilizers recorded, 63.84 to 65.06 per cent sand, 23.64 to 24.01 per cent clay and 11.04 to 12.18 per cent silt respectively in main crop and in ratoon crop, sand, clay and silt content ranged from 64.56 to 65.15 per cent, 23.68 to 26.17 per cent and 8.68 to 11.67 per cent respectively. This values were more or less same when compared with initial soil sample of the experimental field. Bulk density ranged from 1.29 to 1.31 g cm^{-3} in main crop whereas in ratoon crop it ranged from 1.31 to 1.36. g cm^{-3}. In both main cop and ratoon crop, application of 100 per cent recommended dose of fertiliser recorded a lower bulk density compared to 50 per cent recommended dose of fertilizer. But compared to initial soil sample lower bulk density was observed from the soil sample collected after the final harvest of both the main and ratoon crop. Celik *et al.* (2010) [4] reported that the application of mineral fertilizers did not show any significant effect on bulk density of soil.

Table 1: Physical properties of the initial soil

Parameters	Content	Textural class
Sand (%)	65.52	Sandy clay loam
Clay (%)	22.18	
Silt (%)	11.30	
Bulk Density (g cm^{-3})	1.46	

Table 2: Effect of irrigation scheduling based on IW/CPE ratio with normal and magnetized water and fertilizer doses on soil texture and bulk density after final crop harvest

Treatments	Main crop					Ratoon crop				
	Sand (%)	Clay (%)	Silt (%)	Textural class	BD (g cm^{-3})	Sand (%)	Clay (%)	Silt (%)	Textural class	BD (g cm^{-3})
Main plot: Irrigation scheduling based on IW/CPE ratio with normal and magnetized water										
I_1: IW/CPE ratio 0.6 with normal water	66.03	23.44	10.53	Sandy clay loam	1.33	66.06	25.36	8.58	Sandy clay loam	1.36
I_2: IW/CPE ratio 0.8 with normal water	64.42	23.41	12.17	Sandy clay loam	1.31	64.77	22.87	12.36	Sandy clay loam	1.34
I_3: IW/CPE ratio 0.6 with magnetized water	63.11	24.93	11.96	Sandy clay loam	1.29	62.99	26.98	10.03	Sandy clay loam	1.32
I_4: IW/CPE ratio 0.8 with magnetized water	64.91	23.71	11.38	Sandy clay loam	1.28	65.33	24.55	10.13	Sandy clay loam	1.32
S.Em (±)	1.50	0.978	1.45		0.027	0.858	1.04	1.22		0.022
CD (0.05)	NS	NS	NS		NS	NS	NS	NS		NS
Sub plot: Fertilizer doses										
F_1: 50% RDF	64.96	24.01	11.04	Sandy clay loam	1.31	64.66	23.68	11.67	Sandy clay loam	1.36
F_2: 75% RDF	65.06	23.64	11.31	Sandy clay loam	1.30	64.56	24.97	10.48	Sandy clay loam	1.33
F_3: 100% RDF	63.84	23.98	12.18	Sandy clay loam	1.29	65.15	26.17	8.68	Sandy clay loam	1.31
S.Em (±)	0.995	0.888	1.01		0.022	0.717	1.11	1.32		0.025
CD (0.05)	NS	NS	NS		NS	NS	NS	NS		NS

Table 3: Interaction effect of irrigation scheduling based on IW/CPE ratio with normal and magnetized water and fertilizer doses on soil texture and bulk density after final crop harvest

	Main crop					Ratoon crop				
Interaction treatments	Sand (%)	Clay (%)	Silt (%)	Textural class	BD	Sand (%)	Clay (%)	Silt (%)	Textural class	BD
I_1F_1	66.20	23.87	9.93	Sandy clay loam	1.30	64.84	23.81	11.35	Sandy clay loam	1.38
I_1F_2	65.56	22.98	11.47	Sandy clay loam	1.36	66.94	23.62	9.44	Sandy clay loam	1.36
I_1F_3	66.34	23.48	10.19	Sandy clay loam	1.35	66.41	28.64	4.95	Sandy clay loam	1.35
I_2F_1	66.20	23.17	10.64	Sandy clay loam	1.32	65.32	19.88	14.81	Sandy clay loam	1.37
I_2F_2	64.30	22.73	12.97	Sandy clay loam	1.33	63.24	23.33	13.43	Sandy clay loam	1.33
I_2F_3	62.77	24.33	12.90	Sandy clay loam	1.29	65.76	25.40	8.84	Sandy clay loam	1.31
I_3F_1	64.51	21.52	13.98	Sandy clay loam	1.34	64.13	25.84	10.04	Sandy clay loam	1.35
I_3F_2	64.18	27.10	8.72	Sandy clay loam	1.28	62.11	27.88	10.01	Sandy clay loam	1.33
I_3F_3	60.65	26.16	13.19	Sandy clay loam	1.25	62.73	27.23	10.04	Sandy clay loam	1.28
I_4F_1	62.92	27.47	9.61	Sandy clay loam	1.30	64.34	25.19	10.47	Sandy clay loam	1.33
I_4F_2	66.20	21.73	12.07	Sandy clay loam	1.26	65.94	25.04	9.02	Sandy clay loam	1.31
I_4F_3	65.60	21.94	12.46	Sandy clay loam	1.27	65.70	23.42	10.89	Sandy clay loam	1.30
S.Em (±)	1.99	1.78	2.02		0.043	1.43	2.21	2.63		0.051
CD (0.05)	NS	NS	NS		NS	NS	NS	NS		NS

Conclusion

Soil texture is a reasonably constant quality, and it was discovered in the study that irrigation scheduling with normal and magnetic water, as well as different fertiliser doses, had no influence on soil physical parameters like sand, clay, silt content, and bulk density.

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