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Effect of magnetic treatment on Inland saline water on the growth and yield of rice cultivation in Sivaganga District

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Abstract
Field experiment was conducted by TANUVAS, Krishi Vigyan Kendra, Kundrakudi, Sivaganga district in farmers' field with eight treatments five replications with randomized block design. The treatments includes T_1 - Magnetized irrigation water with Eciw 4.6 dSm^{-1}, T_2 - Unmagnetized water with Eciw 4.6 dSm^{-1}, T_3 - Magnetized irrigation water with Eciw 5.7 dSm^{-1}, T_4 - Unmagnetized irrigation water with Eciw 5.7 dSm^{-1}, T_5 - Magnetized irrigation water with Eciw 7.1dSm^{-1}, T_6 - Unmagnetized irrigation water with Eciw 7.1 dSm^{-1}, T_7 - Magnetized irrigation water with Eciw 8.3 dSm^{-1}, T_8 - Unmagnetized irrigation water with Eciw 8.3 dSm^{-1}. Sivaganga district cover more than 85000 hectares of rice cultivation through semi dry rice cultivation. The blocks of Ilayangudi, Kalayarkovil, Sivagangai and Manamadurai Blocks are identified as the most vulnerable area with high salinity in soil and irrigation water. It is estimated to the tune of 26,000 hectares are not suitable for cultivation with the water available due to high levels of salinity in irrigation water. The farmers in this vulnerable area tend to operate crop cultivation only after northeast monsoon showers. If sufficient precipitation is not expected, the lands meant for cultivation would be kept ideal with no cropping**.** Based on the overall performance of the treatments magnetically treated water significantly recorded the higher growth, yield attributes of rice cultivation.

Keywords: Magnetic water treatment, inland saline water, rice cultivation

Introduction
Rice (*Oryza sativa* L.) is important staple food of India to feed the current population it is a need of hour to brought problematic irrigation water to cultivation. Based on the random survey and KVK soil analytic reports it found that some of the blocks in Sivaganga district worstly affected areas with varied degrees of EC levels (Electrical Conductivity) from 4.6 to 9.2 dSm^{-1} which does not permits the rice crop could not cope up to the estimated yield of 3.5-4.0 tonnes per hectare and whereas saline tolerant varieties were found as low performing. Magnetic technology can become a useful tool, as proved by many researchers, to tackle problems related to reduced crop productivity due to use of saline water in agriculture. Shrinking surface fresh water resources, increasing salinity of ground water, rising demand for water by urban and farming communities have made it difficult for planners to manage this precious resource to the satisfaction of all stakeholders. At present, about 85 per cent of India's fresh water resources are being utilized in agriculture and remaining 15 per cent in industrial and domestic sector (Minhas and Samra, 2004) [6]. Magnetized water applied to salty soil is reported to break down salt crystals and help in faster leaching of salts. With this background, the present investigation was conducted to study the effect of saline water irrigation with magnetic treatment on water quality parameters, plant growth and yield attributes and cost economics.

Materials and Methods
The present study was conducted at selected locations of farmer's field of Sivaganga District which is located in the southern agro climatic zones of Tamil Nadu. A total of five farmers field were selected based on the survey of water quality during the year 2018-2019 to study the effect

of magnetized water on irrigation water quality, soil properties, growth and yield of rice. The crop sowing was taken in the rabi season and crop management was done based on TNAU Crop Production Guide. The variety used for the demonstration purpose is CSR 43 along with the farmers practice as BPT 5204. Each crop sown in area of 0.4 hectare before the sowing the green manure daincha was sown in the field and puddle into the 45 DAS. The trial was formulated in randomized block design with eight treatments with three replications and data were statistically analyzed. Five plants were selected at random from each plot for taking observations on growth and yield parameter of rice. A permanent magnet neodymium make with magnetic strength of 6500 gauss power which was rare earth magnet with inside arrangement 28 Nos., with halfback array orientation covered by stainless steel was used in this study for magnetizing irrigation waters. A separated PVC pipeline with ball wall is fitted for unmagnetized water. Water from the bore well separates two treatments namely magnetized water and unmagnetized water. The device can fitted with 2.5 inches pipe with length of 18 inches, OD Core Pipe of 60.3 mm and outer shell 114.3 mm.

The pH of irrigation water was determined by using Systronics direct digital conductivity meter (Sparks, 1996) [7]. Electrical conductivity of the water was determined by using Systronics direct digital conductivity meter-304 (Sparks, 1996) [7] and total dissolved salts (dsm^{-1}). The plant growth attributes were observed *viz*., plant height was measured from the base of the plant to the growing tip and the mean of five plants was taken in each plot and expressed in centimeter, number of productive tillers (nos.), grain yield ($kg\ ha^{-1}$). The experimental site was irrigated by bore well water. Representative irrigation water sample was collected and analyzed (Jackson, 1973) [4] for various characteristics. The quality parameters of the irrigation water used in the present study are presented in Table 1.

Table 1: Quality of irrigation water used

Sl. No.	Properties of water	Loc. 1	Loc. 2	Loc. 3	Loc. 4
1.	pH	7.6	8.1	8.3	8.6
2.	EC (dSm^{-1})	4.6	5.7	7.1	8.3
3.	Cations (meq lit^{-1})				
a	Calcium	8.9	9.5	11.5	14.4
b	Magnesium	9.3	10.2	11.9	15.3
c	Sodium	8.1	8.3	8.5	9.2
d	Potassium	1.2	2.3	3.5	3.9
4.	Anions				
a	Carbonates	4.9	5.3	6.1	7.4
b	Bicarbonates	8.5	8.7	9.3	9.1
c	Sulphates	7.2	8.3	8.7	9.3
d	Chloride	13.9	14.1	15.3	16.2

Results and Discussion

The results of effect of magnetic treatment of inland saline water on pH, EC and TDS are presented in table 2. In the magnetically treated water, there are maximum four hydrogen bridge connections containing protons that spin to the same direction. These are called clusters. Water that is completely organized consists of clusters. The clusters are not stable but very sensitive and unstable units. The influence of the magnetic fields on water is reported to change the dimensions of that clusters, which affects the physical properties of water. When inland saline water passes through the magnetic water softner, the pH significantly decreased compared with magnetically untreated inland saline water. Whereas in ECiw is also get reduces when the water passed through the magnetic water softner of 1950 ppm to 1850 ppm respectively. Grewal and Maheshwari (2011) [2, 5] observed same changes in the physical and chemical properties of water (hydrogen bonding, polarity, surface tension, conductivity, pH and solubility of salts) due to magnetic treatment. They attributed change in pH to mainly changes in hydrogen bonding. The results of this study showed a significant increase in pH with magnetic treatment of saline water. Similar result was reported by Alkhazan and Saddiq (2010) [1]. When a magnetic field is applied to normal water it restructures water molecules into smaller molecule clusters each made up of six symmetrically arranged molecules (Maheshwari and Grewal, 2013) [2, 5].

Table 2: Effect of Magnetic treatment and Unmagnetized Inland saline water on pH, ECiw and TDS

	Treatments	pH	EC (dSm^{-1})	TDS (ppm)
T_1	Magnetized irrigation water with Eciw 4.6 dSm^{-1}	7.9	4.6	1950
T_2	Unmagnetized water with Eciw 4.6 dSm^{-1}	7.7	4.4	1850
T_3	Magnetized irrigation water with Eciw 5.7 dSm^{-1}	8.1	5.7	2580
T_4	Unmagnetized irrigation water with Eciw 5.7 dSm^{-1}	7.9	5.3	2427
T_5	Magnetized irrigation water with Eciw 7.1dSm^{-1}	8.4	7.1	3520
T_6	Unmagnetized irrigation water with Eciw 7.1dSm^{-1}	8.3	6.9	3012
T_7	Magnetized irrigation water with Eciw 8.3 dSm^{-1}	9.1	8.3	4558
T_8	Unmagnetized irrigation water with Eciw 8.3 dSm^{-1}	8.7	7.5	4012

Effect on plant growth attributes and grain yield of rice

The plant height, number of productive tillers, grain yield of paddy was significantly influenced by magnetic treatments as well as EC levels of irrigation water were presented in table 3. The highest plant height (95.8 cm) was recorded in the magnetic water treated plants compared to magnetic untreated paddy. Among the EC levels, the highest plant height was recorded in 4.6 EC water in both magnetic treated and untreated treatment (95.8 and 94.2 cm, respectively). Paddy crop with higher EC levels 8.3 recorded the lower plant height *i.e.* 88.5 (MT) and 82.9 cm (UMT) in both magnetic treated and untreated treatments, respectively. The Number of productive tillers per

m^2 was significantly influenced by magnetic treatments of inland saline irrigation water (Table 3). The higher productive tillers (365) were recorded in the magnetic treated water compared to magnetic untreated paddy crop. Among the EC levels, the higher number of tillers was recorded in 4.6 EC water in both magnetic treated and untreated treatment (365 and 342, respectively). The rice yield was significantly influenced by magnetic treatment of inland saline water (Table 3). The highest grain yield was recorded in the low EC level 4.6 with magnetic treatment of saline water 6.3 t/ha compared to magnetic untreated paddy. Paddy crop with higher EC levels 8.3 recorded the lower grain yield of 3.3 t/ha and 1.75 t/ha in both magnetic treated and untreated treatments, respectively. Results of this experiments revealed that significant effects of magnetic field treatment on saline water quality and crop yield maize which was pay a way to use low quality water for irrigation under water scarcity conditions.

Table 3: Effect of Magnetic treatment and unmagnetized Inland saline water on plant growth, yield attributes and grain yield of rice

Treatments	Plant height (cm)	No. of productive tillers per m^2	Grain yield (kg ha^{-1})
T_1 Magnetized irrigation water with Eciw 4.6 dSm^{-1}	95.8	365	6350
T_2 Unmagnetized water with Eciw 4.6 dSm^{-1}	94.2	342	3875
T_3 Magnetized irrigation water with Eciw 5.7 dSm^{-1}	92.3	345	5375
T_4 Unmagnetized irrigation water with Eciw 5.7 dSm^{-1}	92.5	327	2350
T_5 Magnetized irrigation water with Eciw 7.1dSm^{-1}	90.8	328	4150
T_6 Unmagnetized irrigation water with Eciw 7.1dSm^{-1}	85.3	318	2150
T_7 Magnetized irrigation water with Eciw 8.3 dSm^{-1}	88.5	315	3370
T_8 Unmagnetized irrigation water with Eciw 8.3 dSm^{-1}	82.9	302	1750
S Ed	9.01	31.2	293.4
CD (P=0.05)	4.13	14.8	131.1

Cost Economics

The economics of paddy cultivation by magnetic treatment and non-magnetic treatment of Inland saline water is depicted in the Table 4. The highest gross income (Rs. 76200) is recorder in EC level of 4.6 with magnetically treated and the highest return per rupee invested was high in the magnetically treated inland saline water is 2.35 where as non-magnetically treated water was 2.14 only. The paddy crop could alleviate the adverse effects of low water potential induced due to salinity by quick ion uptake, accumulation of osmotically active solutes (osmotic adjustment) and other physiological adaptations. In tolerant species there is invariably exclusion of potentially toxic ions and accumulation of neutral organic solutes, which contribute to osmotic potential of the cytoplasm. It is established that there are significant physiological differences among susceptible and tolerant varieties of crops under salt stress and hence these could be of use in a proposition for their adaptation as economical crops under salt affected soils.

Table 4: Gross Income, Gross Cost and benefit cost ratio of rice

Treatments	Gross income (Rs.)	Gross Cost (Rs.)	B:C
T_1 Magnetized irrigation water with Eciw 4.6 dSm^{-1}	76200	32450	2.35
T_2 Unmagnetized water with Eciw 4.6 dSm^{-1}	46500	21750	2.14
T_3 Magnetized irrigation water with Eciw 5.7 dSm^{-1}	64500	30500	2.11
T_4 Unmagnetized irrigation water with Eciw 5.7 dSm^{-1}	30360	18000	1.69
T_5 Magnetized irrigation water with Eciw 7.1dSm^{-1}	49800	22850	2.18
T_6 Unmagnetized irrigation water with Eciw 7.1dSm^{-1}	25800	12950	1.99
T_7 Magnetized irrigation water with Eciw 8.3 dSm^{-1}	40440	20400	1.98
T_8 Unmagnetized irrigation water with Eciw 8.3 dSm^{-1}	21000	12040	1.74

Conclusion

The results of present investigation could be concluded that Magnetized irrigation water with Eciw 4.6 dS m^{-1} (T_1) recorded the higher growth, yield of rice. The benefit cost ratio was higher in the magnetized water. Hence it may concluded that magnetized irrigation water along with Integrated crop management practices with CSR 43 variety may recommended to the farmer to get yield and income.

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