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Effect of Electric Current on Wheat (*Triticum aestivum L.*)

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Abstract Present investigations were undertaken to study the effect of electric current on growth parameters, yield parameters and nutritional value of the wheat. (***Triticum aestivum L.***). During this study, effect of electric current has shown a good response to growth parameters, yield parameters and nutritional value of Wheat. Wheat cv. HD-2189 seeds were used with four treatments viz. Control (T_1 - without electric current) and 3V (T_2), 6V (T_3) and 9V (T_4) in three replications each. Field applied with 9V electric current has shown a significant effect to increase growth parameters like height of plant, length of root, number of leaves, number of florets, and length of spike. Yield parameters like the number of seeds per plant, seed weight and seed size were also increased due to the application of 9V electricity. The application of electricity has also shown significant effect to change the nutrient content of wheat. The total fiber, carbohydrate and protein content of the wheat were increased significantly due to the application of 9V electricity. There was no significant effect of electric current on the fat content of wheat. Present investigations clearly indicate that the application of electric current has a significant role to increase yield and nutritional value. This field of research is in the initial stage and more research should be carried out to ease the application of electricity and to explore the effect of electricity on different crop plants.

Keywords Electric Current, Wheat (*Triticum Aestivum* L.), Growth Parameters, Yield Parameters and Nutritional Value

1. Introduction

The use of chemicals in agriculture has enhanced productivity of the crops but it has many adverse effects especially on the environment and health of consumers. Organic farming is supposed to be the substitute for conventional farming but it has certain challenges like insufficient resources, certification non-acceptance by small farm holders, etc. Therefore, there is an urgent need to develop a new suitable strategy in the farming sector.

Electric current plays an important role in plant life and externally applied electric current improves the plant growth and yield [1]. This application of electric current to improve plants is known as Electroculture. Electroculture can accelerate growth and it can increase yield [2]. Application of electric current protects plant from disease, insect and frost, this method also reduces the requirement for fertilizer or pesticides [3]. Electrical treatment enhances the seed vigor by stimulating the biochemical process which involves free radical and by stimulating the activity of proteins and enzymes [4]. Bai, et al., found that application of a 4 kV/m electric field on barley seeds increases free radical in seeds [5]. Electric fields inhibit the biological properties of membrane proteins [6]. An increase in cotton yield by 12.4 % was recorded due to the application of electric current [7]. The high voltage electrostatic field stimulates beet seed germination and it also increases the amount of sugar in beet [8]. Effect of electric current on *Raphanus* and Groundnut was studied by Patil [9] respectively Bhagyawant and Patil [10] and found that there is an increase in the seed germination, growth parameters and yield parameters.

Previous work conducted by different workers shows positive as well as negative impacts of electric current on plant growth and yield in different regions of the world. Therefore, more work should be carried out in the world to study effect of electric current on different plants in different regions of the world.

The present investigation was undertaken to study the effect of electric current on growth parameters, yield parameters and nutritional value of the wheat.

2. Materials and Methods

An experiment was conducted at Late Ramesh Warpudkar ACS college, Sonpeth, Parbhani India (19° 1'34''N and longitude 76° 28'18''E at the elevation of 437 m) during the Rabi season between November 2019 to March 2020. The experiment was laid out in a randomized complete block design (RCBD). Three replications with the unit plot size of 100 sq. feet (3.05m × 3.05m) where row-to-row distance was 30 cm and plant-to-plant were 15 cm. Wheat seeds cv. HD-2189 were obtained from Vasantrao Naik Marathwada Agriculture University, Parbhani. Four treatments were applied - Control (T_1 - without electric current) and 3V (T_2), 6V (T_3) and 9V (T_4).

Electric current treatment was given daily in the morning (8am) for 10 min till the harvesting with the help of copper electrodes buried in the soil at equal distances and connected with each other by wire and finally to the DC source as shown in Plate I.

Growth parameters were studied ninety days after sowing while yield parameters and nutritional value were studied after harvesting.

Growth parameters viz. The height of the plant (cm) and length of the root (cm) was measured using a scale and the number of leaves, spikes, and seeds were counted numerically. Yield parameters viz. Seed size (mm) was measured by the method described by Wankhade et al. [11]; 1000 seed weight (gm) was measured using electric balance. The estimated yield was calculated quintal/hectare by multiplying with 10.764 by the actual weight of seeds yielded from the experimental plots.

To study the nutritional value of wheat fibre content (%), Total carbohydrates (%), Total protein (%) and Total fat (%) of the wheat were estimated by following standard methods described by AOAC [12], FAO [13] and IS 3579 (1966) RA 2016 [14].

The observations were recorded and tabulated in tables. ANOVA was carried out to find out the significance of the results.

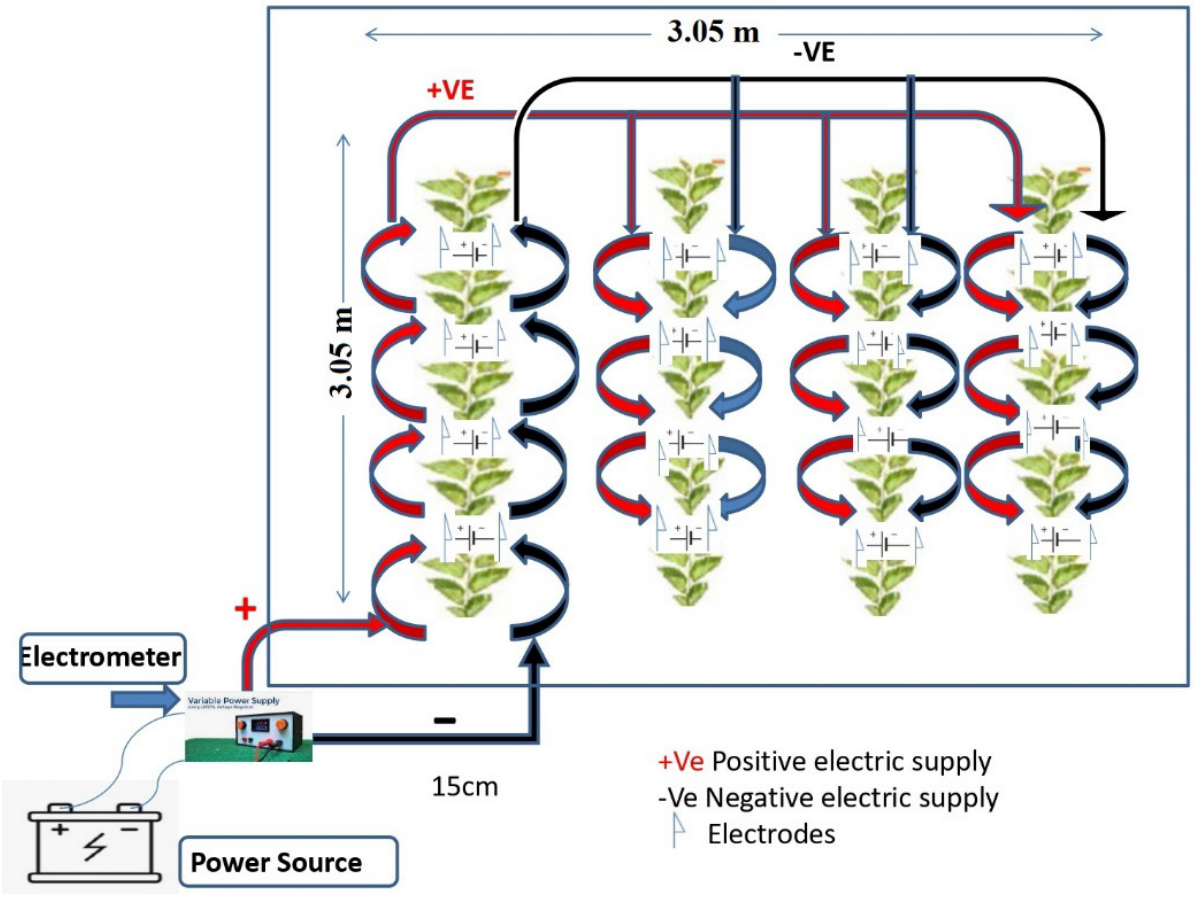

Plate 1. Application of electric current in field

3. Result and Discussion

3.1. Effect of Electric Current on Growth and Yield Parameters of Wheat

The height of the plant was significantly increased due to the application of electric current. The maximum height was recorded in the field applied with 9V electric current [T4] (52.27 cm) followed by the field applied with 6V electric current [T3] (50.74 cm). Field applied with 3V electric current [T2] has shown a decrease in the height of the plant (43.08cm) but it was statistically non-significant (Table 1). Thus, it is clear that the application of 6V and 9V electric current [T4] to the Wheat plant is significant to increase the height of the plant. Similar results were recorded by Rio and Rio in Okra, tomato and egg plant [15], Ahmad et al. in choy Sam and beans [16].

Maximum root length was recorded in the field applied with 9V electric current [T4] (6.90cm) followed by the field applied with 6V electric current [T3] (6.64cm). In T3 as well as in T4 increase in the root length was significant at p=0.01. In the field applied with 3V electric current [T2] root length was 5.33cm it was statistically significant at (p =0.05). The average root length in the control [T1] was 4.56 cm (Table 1). Thus, the application of electric current has shown an increase in root length significantly. Such a significant effect of electric current on root length was recorded in chickpea (Cicer arietinum L.) [17], Dioscorea opposite [18] and Raphanus [9].

In the field maximum increase in the length of the spike (7.50cm) was recorded in the field applied with 9V electric current [T4] followed by the field applied with 6V electric current [T3] (6.67 cm) and 3V electric current [T2] (6.20cm) which is highly significant at p= 0.05. The length of the spike in control [T1] was 5.27cm (Table 1).

The field applied with 9V electric current [T4] has shown a maximum number of Florets per plant (52.04) followed by 6V electric current [T3] (43.8 4) and 3V electric current [T2] (40.32). Statistically, this increase in the number of florets per plant due to the application of 6V and 9V electric current [T4] was highly significant but it was decreased non-significantly due to the application of 3V [T2] electric current (Table 1).

A number of seeds per plant was measured numerically from the plants selected at random. The application of electric current has shown a significant effect on the number of seeds per plant. field application of electric current has shown an increase in the number of seeds per plant. A maximum number of seeds per plant was recorded in the field applied with 9V electric current [T4] (44.44) followed by the field applied with 6V electric current [T3] (40.88) and 3V electric current [T2] (38.36). All these results were significant at (p= 0.05) over the value of control [T1] which is 33.48 seeds/plant (Table 2). Similar results were reported in Wheat [19].

The maximum increase in seed size was recorded in the field applied with 9V electric current [T4] (26.6mm) which was statistically significant at p=0.05. There was an increase in seed size in the field applied with 6V electric current [T3] and 3V electric current [T2] but it was statistically non-significant. In the control [T1] size of the seed was 19.99mm (Table 2) From the above results it is clear that the application of electric current significantly effects on seed size of Wheat.

In the field applied with 9V electric current [T4] weight of 1000 seeds was 54.47gm. There was an increase in the seed weight due to the application of 3V and 6V electric current but it was statistically non-significant (Table 2). Similar results were recorded by Alexander and Doijode in rice [20].

Yield in the experiment field was recorded in Kilogram and it was converted into quintal/hectare by multiplying yield from the respective plots with 10.764. The yield was increased with the application of electric current. It has shown a significant effect on yield. The field applied with 9V electric current [T4] has given maximum yield (50.26 q/ hectare) followed by the field applied with 6V electric current [T3] (49.94 q/hectare) which was significant (p=0.05). Field applied with 3V electric current [T2] has given 34.87q/hectare yield which was statistically non-significant. In control [T1] estimated yield was 32.57q/hectare (Table 2). An increase in yield due to electric field was reported in soybean [21, 22]; maize [23], cabbage [24]; in Tomato [25].

3.2. Effect of Electric Current on Nutritional Value of Wheat

A study of the effect of electric current on the nutritional values of Wheat has shown that electric current has a role to change fibre, carbohydrate, protein and fat content. Applying 3V and 6V electric current [T2 and T3] has increased total fibre content but statistically, it was non-significant. The maximum increase in fibre content was recorded in the field applied with 9V electric current [T4] and it was statistically significant at (p=0.05). In control [T1] it was (1.98%). The total carbohydrate content in control [T1] was 73.44%. Application of 3V and 6V electric current [T3] has shown an increase in total carbohydrate content but statistically, it was non-significant. The maximum increase in carbohydrate content was recorded in the field applied with 9V electric current [T4] (83.26%) and it was statistically significant at (p = 0.05). (Table 3).

In control [T1] total protein content was (9.23%) the protein content of Wheat seed was significantly increased in the field applied with 6V electric current [T3] (13.56%) and 9V electric current [T4] (14.89%) but field applied with 3V electric current [T2] has shown an increase in total protein content (12.33%) which was statistically non-significant. Total fat content was increased in the field applied with electric current but statistically, it was

non-significant (Table 3). Such type of change in the nutritional value of the wheat was also recorded by certain workers recently Zahoor and his coworkers reported that the application of a pulse electric field increase protein content up to 16.76% in Wheat seeds [26]; Hanafy and his coworkers reported that electrostatic field with 50Hz, 6kV/m, 66kV/m significantly increase the total protein and carbohydrate content in Wheat plant [27].

From the above experiments, it is clear that electricity has a definite role to make changes in the growth and yield parameters of Wheat. It also affects the nutritional value of the wheat. More work should be done in this field to observe the effect of electric current on cell permeability and its impact on the soil micronutrients, its positive effect will be useful to develop a new trends in agriculture.

Table 1. Effect of Electric current on Growth Parameters of Wheat

Sr. no.	Character	Control (T_1)	3 V (T_2)	6V (T_3)	9V (T_4)	SE	CD 5%	CD 1%
1	Height of plant (Cm)	44.50	43.08^{NS}	50.74**	53.27**	1.42	2.85	3.79
2	Length of root (Cm)	4.56	5.33 *	6.6 4**	6.90**	0.37	0.73	0.98
3	Length of spike	5.27	6.20 **	6.67 **	7.50 **	0.21	0.41	0.55
4	Number of florets per plant	41.00	40.32^{NS}	43.84**	52.04**	1.31	2.62	3.49

(* - Significant at p=0.05, ** - Significant at p=0.01, NS – Non Significant)

Table 2. Effect of electric current on Yield parameters of Wheat

Sr. No	Characters	Control (T_1)	3 V (T_2)	6V (T_3)	9V (T_4)	SE	CD 5%	CD 1%
1	Number of Seeds/plants	33.48	38.36**	40.88**	44.44**	1.22	2.44	3.24
2	Seed Size (mm)	19.99	20.41^{NS}	21.1^{NS}	26.6*	1.54	4.90	9.01
3	Wight of 1000 Seeds (gm)	50.45	51.33^{NS}	52.29^{NS}	54.47*	0.87	2.76	5.07
4	Estimated yield (q/ha)	32.57	34.87^{NS}	49.94*	50.26*	4.75	15.11	27.75

(* - Significant at p=0.05, ** - Significant at p=0.01, NS – Non Significant)

Table 3. Effect of Electric current on Nutritional Values of Wheat

Sr. No.	Name of test	Control (T_1)	3 V (T_2)	6V (T_3)	9V (T_4)	SE	CD 5%	CD 1%
1	Fibre Content (%)	1.98	2.195^{NS}	3.37^{NS}	4.46*	0.51	1.63	3.00
2	Total Carbohydrates Content (%)	73.44	77.85^{NS}	76.69^{NS}	83.26*	2.04	6.50	11.93
3	Total Protein Content (%)	9.23	12.33^{NS}	13.56*	14.89*	1.21	3.85	7.06
4	Total Fat Content (%)	3.76	1.28^{NS}	2.18^{NS}	5.17^{NS}	0.86	2.74	5.02

(* - Significant at p=0.05, ** - Significant at p=0.01, NS – Non Significant)

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