Original Research Paper

Volume-7 | Issue-12 | December-2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 86.18

Science

STUDY OF PRE-SOWING MAGNETIC TREATMENT ON THE GERMINATION, GROWTH AND YIELD OF OKRA *(ABELMOSCHUS ESCULENTUS)* AND CHILLI (*CAPSICUM ANNUM L.*) SEEDS

Rajiv Vaidya — Sheth P. T. Arts and Science College, Godhra, Dist. Panchmahal, Gujarat, India

Dipak Bokha — ARIBAS, New Vallabh Vidyanagar, Dist. Anand, Gujarat, India

K. R. Patel — Biogas Research Centre, Gujarat Vidyapith, Sadra

ABSTRACT An attempt has been made to study the effect of magnetic field on germination, growth and yield of Okra *(Abelmoschus esculentus)* and Chilli *(Capsicum annum L.)* seeds. The genetically uniform dry seeds were exposed to magnetic field induced by an electromagnet. The seeds were exposed to 50 mT, 100 mT and 200 mT magnetic field for 5, 10 and 30 minute period. The seeds with no magnetic field treatment were considered as control. Both treated and non-treated seeds were sown in similar conditions. Several growth parameters were measured, including germination rate, root length, stem height and numbers of secondary roots. The results showed that magnetism had a significant positive effect on plant growth. Plant seeds under the influence of the magnetic field had a higher germination rate compare to the control. No adverse effects of magnetism on plant growth were noticed.

KEYWORDS : Okra (Abelmoschus esculentus), Chilli (capsicum annum L.), Electromagnetic seed treatment, Germination, Seedling growth, Yield

Introduction:

The investigations about electromagnetic effects on plants have already been carried out with some remarkable results. The optimal external electromagnetic field could accelerate the activation of seed germination (Balouchi & Sanavy, 2009). Agricultural sciences take an interest not only in the common and valued crop-forming factors, but also in those less expensive and generally underestimated, though more pro-ecological ones, such as ionizing, laser or ultraviolet radiation, and electric and magnetic fields. From among these the least troublesome and expensive, and at the same time not dangerous to the environment, seems to be biostimulation with magnetic field.(Kordas, 2002) Stimulation of plants with magnetic field, as a way to increase the quantity and quality of yields, has caught the interest of many scientists in all the world(Chastokolenko, 1984) the growth and yield of lettuce could be improved by treatment of its seeds before they were grown, using rectified sinusoidal non-uniform electromagnetic fields. It was observed that magnetism has effects on lettuce at the nursery, vegetative, and maturity stages, including a significant increase in root length and shoot height, a greater growth rate, and a significant increase in plant height, leaf area, and fresh mass. Positive biological effects of magnetism on sunflower and wheat seedlings weights were reported (Souza et al., 2006). In present work authors focused mainly on the two different plant seeds namely, Okra (*Abelmoschus esculentus*) and Chilli (*capsicum annum L.*).

Okra *(Abelmoschus esculentus)* also known as "lady finger" is one of the highly nutritious vegetables and an important vegetable crop throughout the world. The plant is cultivated throughout the tropical and warm temperature regions around the world for its fibrous fruits. Pods should be harvesting within 10 weeks of planting. It is rich sources of dietary fiber, and contain healthy amounts of vitamin A, and flavonoid. Moreover it is also good source of protein, carbohydrates, calories, folic acid, calcium, magnesium, and dietary fiber. Okra is not only used as vegetable but also have some industrial applications like in rope making and paper industry, further its seed oil is used for food as well as for biodiesel production (Naz et al., 2012).

Chilli (*Capsicum annuum L.*) is the second-most consumed vegetable worldwide and is characterized by its high levels of vitamin C (ascorbic acid), pro-vitamin A (carotene) and calcium. In fact, intakes of 50–100 g fresh chilli could provide 100% and about 60% of the recommended daily amounts of vitamin C and A, respectively. Despite their fiery "hotness", Chilli is one of very popular spices known for medicinal and health benefiting properties. Mature chilli are also rich in carotenoids, compounds with antioxidant and anti-carcinogenic capacity; furthermore, either immature or mature fruits contain a high concentration of antioxidant phenolic compounds(Burt, 2005) (Mateos et al., 2013). Early laboratory studies on experimental mammals suggest that capsaicin has anti-bacterial, analgesic and anti-diabetic properties. It also found to reduce LDL cholesterol levels in obese individuals. Chilies contain a good amount of minerals like potassium, manganese, iron, and magnesium. Chilies are also good in B-complex.

Objectives:

1. To know the influence of magnetic field intensity on seed quality attributes of commercial crop seeds namely; Okra (Abelmoschus esculentus) and Chilli. (capsicum annum L.)
2. To study the effect of magnetic field intensity exposure time on seed quality attributes of commercial crops.
3. To know the influence of interaction between dose of magnetic field intensity and its duration on seed quality attributes of different vigour level seeds of commercial crops.
4. To observe plant growth based on a set of growth under the magnetic field.
5. To determine whether magnetic field can influence plant growth based on the observational data.
6. To identify parameters of plant growth affected by the magnetic field, if any.

Materials:

1. Plant seeds- a bag (Okra (Abelmoschus esculentus) and chilli (capsicum annum L.)
2. Water
3. Magnetic field generator unit-Electro magnets [Figure-1 and 2]
4. Magnetic field measurement unit-Gauss meter
5. Blotting paper sheet
6. Petri Plates [6 inch diameter]

Procedure:

1. Genetically uniform seeds of Okra *(Abelmoschus esculentus)* and chilli (*capsicum annum L.*) were collected from AAU (Anand Agriculture University), Anand , Gujarat ,India .
2. Seeds were soaked in a tape water for overnight to make its skin softer; then after given fungicides (bavastine) treatment for five minutes and washed repeatedly by tap water.
3. Seeds were distributed in three test tube set (5 seeds / test tube) and then applied a static magnetic field at different magnetic level at different time of exposure.

3.1 First experimental sets were designed for 50 mT for 5, 10 and 30 minutes.

3.2 Second one were designed for 100 mT for 5, 10 and 30 minutes.

3.3 Last one were designed for 200 mT for 5, 10 and 30 minutes.

4. After applying magnetic field, seeds were taken for further germination, in autoclaved petri plates with perfectly trimmed blotting paper in it and allowed to grow at room temperature.
5. The daily observations of number of seeds germinated, root length, shoot height, no. of secondary roots were recorded.
6. The observations were taken for two week and compared to a control.

Figure 1: Experimental setup. for treatment of MF.

Figure 2: Electromagnet used

Result:

There were four set under observations- (1) without magnetic field (control) (2) 50mT for 5,10,30 minute (3) 100mT for 5,10,30 minute and (4) 200mT for 5,10,30 minute. Control showed to have a slower growth; moreover the germination rate of it was slow when compared with experimental plant. Table-1 shows the comparative data of number of seeds germinated for Chilli for first week of observation. For okra, it was observed that all seeds were germinated from second day in experiment including control. The significantly higher germination rate in first week was observed for all set parameters compared to control.

Table-1: The data of number of Chilli seeds germinated.

Number of Seed Germinated in Chilli out of 5 seeds												
mT\Min	5 min				10 min				30 min			
	Day 3	Day 4	Day 5	Day 6	Day 3	Day 4	Day 5	Day 6	Day 3	Day 4	Day 5	Day 6
50 mT	1	5	5	5	2	4	5	5	1	3	5	5
100 mT	1	4	5	5	1	4	4	5	0	4	4	5
200 mT	2	5	5	5	1	3	3	4	1	3	4	5
Control	0	1	3	4	0	1	3	4	0	1	3	4

Figure 3 shows the growth of chilli seeds treated magnetically for 50 mT, 100 mT and 200 mT for period of 5min, 10 min and 30 min. The figure shows the comparative between control and magnetic effect. Magnetically treated seeds show better growth compare to control in terms of root length and stem height.

Figure 3: The growth of magnetically treated chilli seeds for period of 5 min, 10 min and 30 min under magnetic field of 50 mT, 100 mT and 200 mT compared to control.

The comparative data of root length and stem height for Chilli seeds germinated under magnetic treatment is depicted in Table 2. As shown in this table, the Chilli seeds with magnetic effect grow taller than compared to control measured in terms of root length and stem height. The maximum root length of 3.9 cm was observed on 8th day in 200 mT for 10 min. exposure. While in case of stem height, the maximum appearance was observed as 4.6 cm on 8th day for 100mT exposure for 5 minute.

Table-2: The comparative data of root length (in cm) and stem height (in cm) of Chilli seeds germinated under magnetic treatment.

Root length of Chilli (*capsicum annum L.*)				
mT\min	50 mT			
	Day 5	Day 6	Day 7	Day 8
Control	1.5	1.7	2	2.2
5 min	2.5	2.7	3.1	3.5
10 min	2.1	2.8	3.3	3.7
30 min	2.1	2.4	2.9	3.1
mT\min	100 mT			
	Day 5	Day 6	Day 7	Day 8
Control	1.5	1.7	2	2.2
5 min	2.5	2.7	2.9	3.1
10 min	2.4	2.7	2.9	3.3
30 min	1.7	2.1	2.5	3
mT\min	200 mT			
	Day 5	Day 6	Day 7	Day 8
Control	1.5	1.7	2	2.2
5 min	2.2	2.4	2.7	3.1
10 min	3.1	3.3	3.6	3.9
30 min	2.8	3	3.3	3.7

Stem Height of Chilli (*capsicum annum L.*)				
mT\min	50 mT			
	Day 5	Day 6	Day 7	Day 8
Control	1.3	1.9	2.1	2.4
5 min	1.7	2.5	2.9	3.1
10 min	1.8	2.4	3	3.3
30 min	1.9	2.3	3.1	3.6
mT\min	100 mT			
	Day 5	Day 6	Day 7	Day 8
Control	1.3	1.9	2.1	2.4
5 min	2	2.9	4.2	4.6
10 min	2.4	3	3.7	4.1
30 min	2.1	2.9	3.7	4.2
mT\min	200 mT			
	Day 5	Day 6	Day 7	Day 8
Control	1.3	1.9	2.1	2.4
5 min	1.7	2	2.9	3.4
10 min	2.3	2.7	3.3	3.5
30 min	2.1	2.6	3	3.4

As shown in Figure 4, the growth of okra seeds treated magnetically for 50 mT, 100 mT and 200 mT for period of 5min, 10 min and 30 min compared to control show better result. Magnetically treated seeds show better growth compare to control in terms of root length, stem height and no. of secondary roots.

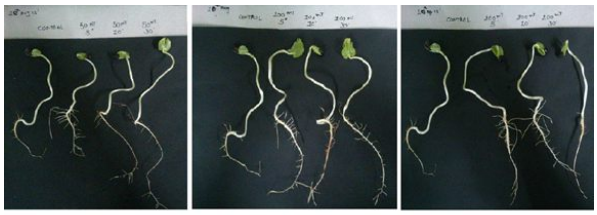

Figure 4: The growth of magnetically treated okra seeds for period of 5 min, 10 min and 30 min.under magnetic field of 50 mT, 100 mT and 200 mT compared to control.

Table 3 shows the comparative data for the measurement of root length and stem height for Okra seeds germinated under magnetic treatment. As mentioned in the table, the Okra seeds with magnetic effect grow taller compared to control, It was measured in terms of root length and stem height. The maximum root length of 12.1 cm was observed on 8th day in 200 mT for 10 min. exposure. The maximum appearance for stem height was observed as 11.1 cm on 8th day for 50 mT exposure for 30 minute.

Table-3: The comparative data of root length (in cm) and stem height (in cm) of Okra seeds germinated under magnetic treatment.

Root Length of Okra (*Abelmoschus esculentus*)				
mT\min	50 mT			
	Day 5	Day 6	Day 7	Day 8
Control	7.3	8.1	8.3	8.9
5 min	8.7	8.9	9.1	9.3
10 min	10	10.5	11.4	11.8
30 min	10.4	11.8	12.8	13
mT\min	100 mT			
	Day 5	Day 6	Day 7	Day 8
Control	7.3	8.1	8.3	8.9
5 min	8.8	9.1	10.4	10.7
10 min	8.9	9.7	9.9	10.1
30 min	9.4	9.9	10	10.3
mT\min	200 mT			
	Day 5	Day 6	Day 7	Day 8
Control	7.3	8.1	8.3	8.9
5 min	5.7	6.1	6.7	8.4
10 min	11	11.3	11.5	12.1
30 min	8	8.4	8.7	9.3

Stem Height of Okra (*Abelmoschus esculentus*)				
mT\min	50 mT			
	Day 5	Day 6	Day 7	Day 8
Control	5.8	6.9	7.3	9
5 min	5.7	6.4	6.6	8.3
10 min	6.2	7.4	8.7	10.9
30 min	6.7	7.4	8.8	11.1
mT\min	100 mT			
	Day 5	Day 6	Day 7	Day 8
Control	5.8	6.9	7.3	9
5 min	4	7.3	8.4	10.2
10 min	7.3	8.6	10.1	11
30 min	7.2	7.5	7.8	9.1
mT\min	200 mT			
	Day 5	Day 6	Day 7	Day 8
Control	5.8	6.9	7.3	9
5 min	8.9	10.2	10.5	10.9
10 min	6.7	8.6	9.2	10
30 min	6.6	6.9	8.1	9.4

Discussion :

The seeds sown after magnetic field pre-treatment showed uniformed germination, fast seedlings growth and enhanced yield of plant compare to control. The current evidence seems in the favor of the view that magnetism has a positive influence on plant growth and development.

The present research suggests that magnetism makes plant grow not only faster and bigger but also survive better.

There are not define that a standard magnetic field and standard time exposure for pre-sowing treatment give to every plant because that will be changes from species to species and it's variety. We observed considerable improvement on germination and growth characteristics in magnetically treated Okra and Chilli.

Conclusion:

The magnetic induction values of 50 mT for Okra variety and 100 mT for Chilli during 10 min and 5-10 min of exposure respectively, incremented the germination percentage and root length during the second week after sowing under laboratory condition. The germination rate in the first week is significantly higher than control.

Furthermore, magnetic treatment can be considered as an alternative to chemical and biological method that are commercially used in the production of vegetable crops.

More research can be done for the exact mechanism behind the magnetic field application on plants and effect of it can be further elucidate on various plant varieties.

Acknowledgement:

The authors are thankful to authority of ARIBAS for providing infrastructure and laboratory facility to carried out this work as a part of M. Sc. dissertation.

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