Standardizationofdifferentdosesanddurationsofelectricandmagneticfieldseedtreatmentongrowth,yieldandyieldattributingtraitsofBottlegourd(*Lagenariasiceraria*L.*)*

Abstract:

ThepresentinvestigationwasundertakentoassessStandardizationofdifferentdosesanddurationsofelectricandmagneticfieldseedtreatmentongrowth,yieldandyieldattributingtraitsofBottlegourd(LagenariasicerariaL.)The experiment was conducted during Rabi season 2022-23 at the field experimental centre, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.).Seeds of Bottle gourd when treated with electric and magnetic field with various doses and frequencies, treatment T□Magneticfield(250mT)performed best in all growth and yield attributing traits when compared to other treatments. This study ishelpful in good crop establishment and prevent the seed from pest and diseases and promotes good yield and as it is chemically free and causes no harm to soil it will also benefit farmers. It is highly cost-effective since once the initial research is done, the process can be easily replicated and scaled.

Keywords:Electricfield,Magneticfield,Bottlegourd, nutritional security, seedtreatment

1. Introduction:

Today's competitive agricultural development environment demands that growers produce high yield of good quality seeds to meet the market demand. In this scenario vegetables play a vital role in the health and nutritional security of human beings in addition to improve the economy of the farmers. Although India is the second largest producer of vegetables in the world next to China with 14t/ha productivity.

The family Cucurbitaceae ranks among the highest of plant families for number andpercentage of species used as human food. In India, the bottle gourd (*Lagenaria siceraria* L.) also known as lauki, kadu, ghiya, or doodhi, is widely farmed. The bottle gourd belongs to family Cucurbitaceae and it is a monecious climbing annual plant native to tropical Africa.

Lagenaria siceraria. L, which has a fleshy fruit and seeded pepo, is a popularly grown vegetable crop in tropical nations. It is commonly cultivated in India, Sri Lanka, Indonesia, Malaysia,Philippines, China, Hong Kong, Tropical Africa, Colombia and Brazil.

Bottle gourd cultivation in India has occupied an area of 192 thousand hectares with an annual production of 3143 thousand million tons with highest production in Bihar state. Uttar Pradesh has occupied an area of 16.81thousand hectares with an annual production of 509.44 thousand million tons. The blooming stage in cucurbits is crucial because it affects both fruiting and productivity. The Staminate and pistillate blooms are found on the same plant in different configurations and individually. In India, bottle gourds are typically harvested in two Seasons: the first from mid-October seeding to mid-March harvesting, and the second from early-March sowing to mid-July harvesting (harvest). It is an annual monoecious plant with a trailing or ascending vine. The stem has a hairy texture and protrudes long, forked tendrils. Flowers have stalks, with the stalks of the female flowers being shorter than the male. They are axillary, unisexual, and solitary. It produces hard-shelled fruits with a variety of morphologies, including long, oblong, and spherical.The fruits have medicinal values and used as cardio-tonic, aphrodisiac, hepato-protective, analgesic, anti-inflammatory, expectorant, diuretic and antioxidantagents [4][8]

The agronomic application of MFs in plants has shown potential in altering conventional plant production systems; increasing mean germination rates, and root and shoot growth; having high productivity; increasing photosynthetic pigment content; and intensifying cell division, as well as water and nutrient uptake.When seeds of garden pea were exposed to full-wave rectified sumusoidal non-uniform magnetic fields of strength 60 mT, 120 mT and 180 mT for 5, 10 and 15 min prior to sowing seed showed significant increase in germination. The emergence index, final emergence index and vigor index increased by 86.43%, 13.21% and 204.60%, respectively[5]. Furthermore, different studies suggest that MFs prevent the large injuries produced/inflicted by diseases and pests on agricultural crops and other economically important plants and assist in reducing the oxidative damage in plants caused by stress situations. Seeds of cucumber when treated withdifferent magnetic field strengths (0.0, 20.0, 40.0 and 60.0 m T), at different time intervals ranging from 0 to 300 minutes on some properties of irrigation water the pH, electric-conductivity (EC), and total dissolved salts (TDS) in cucumber, the results demonstrated that the magnetic treatments improved plant height, yield (kg/m2), fruit length, fruit diameter, and leaves dry matter percentage of cucumber plant compared to control treatment[11]. An improved understanding of the interactions between the MF and the plant responses could revolutionize crop production through increased resistance to disease and stress conditions, as well as the superiority of nutrient and water utilization, resulting in the improvement of crop yield. The seeds of maize (*Zea mays* L.) var. Ganga Safed 2 were exposed to static MFs of 100 and 200 mT for 2 and 1 h, respectively. MF exposure of seeds significantly enhanced all growth parameters, compared to the control seedlings[1].“The electric field affects plants in both soil and air, as the Earth has an electrified environment maintained by a global circuit. Plant cells contain membrane potential because of ion channels or pumps that allow electric current to flow through them [10]**.**[13]showed the impact of air anions on the growth of lettuce and kale, respectively”. [2]**“**When corn hybrids was assessed using biophysical methods, seed was exposed to electromagnetic field at an intensity of 480 mT. Hybrids San Juan and San Jose and five times of exposure (3, 6, 9, 12 and 15 min) were evaluated, as well as a (non-irradiated) control, average grain yield 9 tons per ha was obtained. With 12 min exposure to electromagnetic field, plant height increased by 0.56% and stem diameter by 3.19%; likewise, yield per hectare was 6.03%, equivalent to 550 kg per ha, compared to the non-irradiated control. San Jose yielded 8.79% more, with 12 min exposure to electromagnetic field, and San Juan 6.52% more, with 6 min”[2]. A study “Standardization of different doses and durations of electric and magnetic field seed treatment on growth, yield and yield attributing traits of Bottle gourd (*Lagenariasiceraria*L.)” has been conducted in order to find out the proper seed treatment for the higher yield production in order to help out the farming communities thereby increasing the yield by treating seeds with electric, magnetic field are used in crop production. Hence, the present study was undertaken to determine the effect of different doses and frequencies of Electric and magnetic field on growth, yield and yield attributing traits of Bottle gourd.

The present study on standardization of different doses and durations of electric and magnetic field seed treatment on growth, yield and yield attributing traits of Bottle gourd (*Lagenaria siceraria* L.*)”* was conducted in a Randomized block design with three replications at field experimentational centre in *Rabi* season (2022-2023), Department of Genetics and Plant Breeding, Naini Agricultural Institute (NAI), Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, UP. The different seed treatment combinations are T□ - Control, T□–Magnetic field 125 mT (1 minute), T□-Magnetic field 125 mT (10 minutes), T□-Magnetic field 125 mT (20 minutes), T□-Magnetic field 250 mT (1 minute), T□-Magnetic field 250 mT (10 minutes), T□-Magnetic field 250 mT (20 minutes), T□-Electric field 300 mA (1 minute), T□-Electric field 300 mA (10 minutes), T□-Electric field 300 mA (20 minutes), T□□-Electric field 500 mA (1 minute), T□□-Electric field 500 mA (10 minutes) and T□□-Electric field 500 mA (20 minutes).

2.1 Methodology:

Magnetic Field treatment method:

Seeds of Bottle gourd were treated with Magnetic field in the Laboratory of Department of Physics, SHUATS, Prayagraj. To treat the seeds electromagnetic field generator "OMEGA EMU-10" with variable horizontal magnetic strength gap of 5cm between pole pieces was used. Magnetic field flows the cylinders when we input the power supply. A DC power supply 230AC (0-4 (10& AC Amp) (10% AC 50HZ) with continuously variable output current was used for the electromagnet. The seeds were treated at 125 mT and 250 mT magnetic field with different time duration 1, 10 and 20 minutes using a digital gauss meter OMEGA DGM-20 (230 AC + 10% AC 50HZ). The metallic probe made of indium arsenide crystal and encapsulated to a non-magnetic sheet is used. This could measure in steps of the magnetic field.

Electric Field treatment method:

Seeds of Bottle gourd were treated with Electric field in the Laboratory of Department of Physics, SHUATS, Prayagraj. To expose the seeds to electric field, an electric field generator was fabricated by using metallic conductor. A battery of 24V DC was used as power source for electric field. Battery is connected with ammeter to measure electric current and ammeter is connected with rheostat to adjust current supply. The seeds are placed on a metallic conductor and electric current of 24V DC was passed at required intensity i.e., 300 mA for different time duration 1, 10 and 20 minutes.

3. Result:

3.1 Analysis of variance and mean performance:

The analysis of variance revealed that there is significant variation in growth and yield attributing traits of bottle gourd when treated with Electric and Magnetic field with different doses and duration respectively recorded in (Tables:1 and 2). Since there was a significant variation it is essential for successful selection to enhance better growth and yield.

3.2Correlation Coefficient Analysis:

Correlation between Growth and yield attributing Traits of Bottle gourd recorded in Table: 3 provides a significant relationship among various growth and yield parameters in Bottle gourd in response to various durations and frequencies.

Field emergence (%) at 10 DAS shows a significant positive correlation with vine length and number of leaves per vine (0.847 to 0.953) suggesting that the faster field emergence simultaneously increased the vine length and number of leaves with in short period of time making it significantly positive, followed byNumber of leaves per vine shows highly negative correlation with days to first appearance of male flowers (-0.932) indicating that there is no significant correlation among number of leaves and days to first appearance of male flowers.

Conversely, days to first appearance of male flowers shows a highly positive correlation with days to first appearance of female flowers (1.000), and days to first appearance of female flowers shows a negative correlation with number of male flowers per vine (-0.981). Days to first appearance of male and female flowers shows negative correlation with many other observations implying that treatment if it rapids flower initiation their will be a rapid fruit development. The number of male flowers per vine and female flowers per vine shows a highly significant positive correlation with number of fruits per vine (0.996 and 0.992), indicating that treatment expediting flowering also accelerate fruit development.The number of fruits per vine shows positive correlation with fruit length and fruit diameter (0.973) indicating that treatments promoting higher fruit production per vine. Followed by fruit length and fruit diameter shows significant positive correlation with single fruit weight (0.908) indicating that treatments not only promote higher fruit production but also increase one individual fruit weight. The single fruit weight shows highly significant positive correlation with number of seeds per fruit (0.967 to 0.997) indicating that treatments not only increases the individual fruit weight but also enhances the seed count in individual fruit. Respectively, seed yield per fruit, vine and hectare shows a strong positive correlation (0.975 and 0.974) indicating that treatments enhance not only germination but also yield traits.

Discussion:

"The present study was conducted with the understanding that use of Magnetic and Electric Field and their benefits for the plant growthand yield attributing traits. Seed enhancement technique like Magnetic and Electric field improves the quality of seed.Static magnetic field of strength from 0 to 250 mT in steps of 50 mT for 1, 2 and 3 h were applied to seeds of chickpea (Cicer arietinum var. Pusa 256). Magnetic field strength of 100mT for 1h exposure was the best in terms of germination of seeds, seedling root and shoot length and dry weight"[9]. "It increases seed germination, crop productivity, and development, a proper combination of MF intensity and time exposure is essential. Cucumber seeds exposed to static magnetic field strength from 100 to 250 mT for 1, 2 or 3 h. Germination-percentage, rate of germination, length of seedling and dry weight increased by 18.5, 49, 34 and 33% respectively in magnetoprimed seeds compared to unexposed seeds. Among different magnetic field doses, 200 mT for 1 h showed significant effect on germination parameters"[6]**.**"Many studies have proved that its positive impacts can improve seed germination, root and shoot length, the absorption of the water and CO_2, the content of the photosynthetic pigments, and finally the increase of the agricultural production even under abiotic stresses. And also helps in good crop establishment and prevent the seed from pest and diseases and promotes good yield.Magnetic field (MF) therapy for plants and animals has been found to be an effective and emerging tool to control diseases and increase tolerance against the adverse environment. MF interacts with seeds and plants and accelerates metabolism, which leads to an improved germination”[12].“The seeds of bitter gourd were exposed to 300, 500, 700 and 1000 V/cm electric field for 20 min. The results showed that electric field stimulates germination of bitter gourd seeds positively at low levels and has a resonating effect at 500 V/cm. At higher electric fields, the germination was decreased sharply”[14].The primary and secondary metabolites, enzyme activities, uptake of nutrient and water are reprogrammed to stimulate the plant growth and yield under favourable conditions. During adverse conditions of abiotic stress such as drought, salt, heavy metal contamination in soil, MF mitigates the stress effects by increasing antioxidants and reducing oxidative stress in plants. The stunted plant growth under different light and temperature conditions can be overcome by the exposure to MF.Exposure of cumin seeds to different intensities of magnetic fields prior to germination significantly increased germination-related characters. The increase in germination, speed of germination, shoot length, root length, total seedling length, seedling fresh weight, and seedling dry weight was, respectively, 14–17%, 14–57%, 8–27%, 25–62%, 16–39%, 10–29%, and 17–49% compared to untreated control seeds[7]**.** An MF treatment lowers the disease index of plants due to the modulation of calcium signaling, and proline and polyamines pathways.The study concluded that the pre – sowing seed treatment with Magnetic field-250mT for (20 minutes) gave the better performance compared to other treatments.

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4. Conclusion:

This study has revealed the impact of various doses and frequencies on growth and yield attributing traits of bottle gourd. Our investigation exhibited that treatment T□-Magnetic field 250 mT (20 minutes) performed better compared to all other treatments in response of each observation. Magnetic field and electric field helps in good crop establishment and prevent the seed from pest and diseases and promotes good yield. As it is chemically free and causes no harm to soil it will also benefit farmers. It is highly cost-effective since once the initial research is done, the process can be easily replicated and scaled.

Conflicts of interest:

There is no conflict of interest.

Disclaimer (Artificial intelligence)

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3.

5. Reference:

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Table: 1Analysisofvarianceforvariousgrowthandyieldrelatedtraits

*** significant at 5% level of significance, respectively.**

S.No	Characters	Mean sum of squares		
		Replication (d.f = 2)	**Treatment (d.f = 12)**	**Error (d.f = 24)**
01	Field emergence (%) at 4 DAS	132.694	2,615.847*	606.566
02	Field emergence (%) at 7 DAS	157.941	3,892.172*	827.739
03	Field emergence (%) at 10 DAS	120.110	4,157.548*	865.571
04	Vine length (cm) at 30 DAS	2.021	57.131*	12.026
05	Vine length (cm) at 60 DAS	44.092	188.005*	31.701
06	Vine length (cm) at 90 DAS	26.597	1,032.393*	123.411
07	Vine length (cm) at 120 DAS	81.479	1,174.448*	89.058
08	Number of leaves per vine 30 DAS	0.001	0.016*	0.019
09	Number of leaves per vine 60 DAS	0.089	0.976*	0.445
10	Number of leaves per vine 90 DAS	0.014	3.471*	1.773
11	Number of leaves per vine 120 DAS	0.510	22.232*	7.569
12	Days to first appearance of male flowers	0.027	238.564*	0.373
13	Days to first appearance of Female flowers	0.107	233.436*	2.560
14	Number of Male flowers per vine	0.075	1.77*	0.298
15	Number of Female flowers per vine	0.057	1.748*	0.289
16	Number of fruits per vine	0.014	2.843*	0.492

17	Fruit length per vine (cm)	1.217	125.083*	24.063
18	Fruit diameter per vine (cm)	2.137	56.172*	10.557
19	Single fruit weight per vine (gm)	0.054	0.226*	0.106
20	Number of seeds per fruit	12.605	93239.607*	1467.443
21	Seed yield per fruit (gm)	274.103	2145.084*	2252
22	Seed yield per Vine (gm)	287.724	29253.134*	4571.194
23	Seed yield per Hectare (q/ha)	0.015	22.501*	0.824

Table -2 Mean performance for observations on standardizationofdifferentdosesanddurationsofelectricandmagneticfield in Bottle gourd

Treatments	FE -10	VL -120	L/V-120	DFAMF	DFAFF	NMF/V	NFF/V	FY	FL	FD	SFW	NS/F	SY/F	SY/V	SY/H
T□	70.3	115.2	24.53	52	56.33	9.4	3.4	3.06	27.33	25.06	0.94	550.51	83.1	292.5	8.55
T□	55.5	106.83	23.6	56.33	60.33	9	3	2.6	24.93	23.4	0.84	477.1	72.02	253.5	7.41
T□	62.9	107.96	24	55.66	59.66	9.06	3.06	2.73	25.33	23.73	0.87	500.95	75.62	266.17	7.78
T□	51.8	97.23	22.4	59	63	8.53	2.86	2.46	24.13	21.33	0.80	451.41	68.14	239.85	7.01
T□	59.2	108.23	24.26	55	59	9.2	3.2	2.8	25.6	24.26	0.88	513.8	77.56	273.33	7.98
T□	66.6	113.2	24.7	53.66	57.66	9.33	3.33	3	26.8	24.6	0.95	550.5	83.1	292.33	8.45
T□	85.1	119.2	25.13	49.66	53.66	9.6	3.6	3.4	30.8	26.33	1.07	623.9	94.18	331.5	9.69
T□	55.5	106.83	23.6	56.33	60.33	9	3	2.6	24.93	23.2	0.83	477.1	72.02	253.5	7.41
T□	48.1	105.83	23.2	57	61	8.93	2.93	2.53	24.67	22.86	0.81	464.25	70.08	246.67	7.21
T□	55.5	108	23.63	55.66	59.66	9.13	3.13	2.8	25.47	24	0.83	513.8	75.56	243.23	7.78
T□□	59.2	112.86	24.26	54.33	58.33	9.26	3.2	2.86	26.27	24.4	0.88	524.81	79.22	278.85	8.15
T□□	74	116.46	24.96	51	55	9.46	3.46	3.26	28.73	25.53	0.99	598.21	90.3	317.85	9.3
T□□	48.1	106.83	23.2	55.66	59.66	9.06	3.06	2.73	25.2	23.73	0.85	500.95	75.62	266.17	7.78
GM	60.9	109.58	23.95	54.71	58.74	9.15	3.17	2.83	26.16	24.03	0.89	519.02	78.19	273.49	8.03
SE (m)	3.46	1.11	0.32	0.87	0.84	0.09	0.06	0.08	0.57	0.38	0.03	4.51	5.59	7.96	0.10
CD (5%)	10.18	3.26	0.95	2.57	2.49	0.28	0.18	0.24	1.69	1.12	0.11	13.25	7.9	23.39	0.31
CV	9.86	1.75	2.34	2.77	2.5	1.8	3.45	5.05	3.82	2.75	7.45	1.5	2.38	5.04	2.3

Table-3CorrelationCoefficientAnalysisfordifferentTraitsinBottlegourd

Traits	FE	VL	L/V	DFA MF	DFA FF	NMF/V	NFF/V	F/V	FL	FD	SFW	NS/F	SY/F	SY/V	SY/H
FE	1														
VL	0.847**	1													
L/V	0.883**	0.953**	1												
DFAMF	-0.914**	-0.969**	-0.932**	1											
DFAFF	-0.914**	-0.969**	-0.933**	1.000**	1										
NMF/V	0.913**	0.948**	0.935**	-0.981**	-0.981**	1									
NFF/V	0.923**	0.940**	0.932**	-0.984**	-0.983**	0.996**	1								
F/V	0.925**	0.931**	0.909**	-0.984**	-0.985**	0.988**	0.992**	1							
FL	0.943**	0.899**	0.862**	-0.964**	-0.967**	0.952**	0.957**	0.973**	1						
FD	0.850**	0.976**	0.948**	-0.974**	-0.976**	0.959**	0.958**	0.951**	0.908**	1					
SFW	0.955**	0.899**	0.895**	-0.962**	-0.965**	0.953**	0.963**	0.967**	0.978**	0.908**	1				
NS/F	0.921**	0.926**	0.909**	-0.978**	-0.981**	0.982**	0.986**	0.998**	0.974**	0.949**	0.967**	1			
SY/F	0.927**	0.927**	0.914**	-0.981**	-0.984**	0.982**	0.985**	0.996**	0.977**	0.945**	0.979**	0.997**	1		
SY/V	0.917**	0.902**	0.899**	-0.958**	-0.961**	0.950**	0.951**	0.957**	0.956**	0.903**	0.983**	0.957**	0.975**	1	
SY/H	0.927**	0.926**	0.909**	-0.982**	-0.985**	0.981**	0.983**	0.996**	0.980**	0.946**	0.976**	0.997**	0.999**	0.974**	1

****.Correlationissignificantatthe0.01level(2-tailed).**

FE=Fieldemergence,VL=Vinelength,L/V=LeavesperVine,,DFAMFDaystofirstappearancemaleflowers,DFAFF=DaystofirstappearancefemaleflowersNMF/V=Numberofmaleflowerspervine,NFF/V=Numberoffemaleflowerspervine,F/V=Numberoffruitspervine,FL=Fruitlengthpervine(cm),FD=Fruitdiameterpervine(cm),SFW=Singlefruitweightpervine(gm),NS/F=Numberofseedsperfruit,SY/F=Seedyieldperfruit(gm),SY/V=Seedyieldpervine(gm),SY/H=Seedyieldperhectare(q/ha)