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International Journal of Current Research
Vol. 9, Issue, 11, pp.60986-60988, November, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

INFLUENCE OF PULSED MAGNETIC FIELD ON YIELD, ITS COMPONENTS AND QUALITY TRAITS IN MAIZE (*ZEA MAYS* L.)

[1,*]Swarnalatha Devi, I., [1]Parimala, K., [2]Leelapriya, T., [1]Venkateswarlu, K., [1]Srikrishnalatha, K. and [1]Vishnuvardhan Reddy, A.

[1]Seed Research and Technology Centre, PJTSAU, Rajendranagar, Hyderabad-500030
[2]Department of Agri Sciences Madras Institute of Magnetobiology, Annanagar, Chennai– 40

ARTICLE INFO

Article History:
Received 28th August, 2017
Received in revised form
16th September, 2017
Accepted 04th October, 2017
Published online 30th November, 2017

Key words:
Pulsed magnetic field, Seed leachate, Vigour, Protein quality, Electrical conductivity.

ABSTRACT

A field experiment was conducted to study the on effect of pulsed magnetic field(PMF) on maize inbred BML-6 during *Kharif*,2012, at Seed Research and Technology Centre, Rajendranagar, Hyderabad. Seeds were exposed to pulsed magnetic fields of varying frequencies viz., 1Hz, 10Hz, 50Hz and 100 Hz with intensity of 1500nT, sine wave for a period of 5 hrs per day for 15 days. The study revealed that 50Hz frequency was found to be most optimal combination which showed the best response for most of the parameters studied viz., cob length, number of seeds row^{-1}, number of rows cob^{-1}, cob weight and grainyield kg^{-ha}. Significant increase in root length, shoot length and seed vigour was observed in all the treatments compared to control. The results suggested that pretreatment of PMF plays an importantrole in improvement of crop productivity of maize through the enhancement of protein, mineral accumulation and enzyme activitiesin seed which leads to increase the growth and yield.

Citation: Swarnalatha Devi, I., Parimala, K., Leelapriya, T. *et al.* 2017. "Influence of pulsed magnetic field on yield, its components and quality traits in maize (*Zea mays* L.)", *International Journal of Current Research*, 9, (11), 60986-60988.

INTRODUCTION

Over many years, the effect of magnetic fields on plant life has been the subject of several studies. Magnetic fields were used widely as pretreatment for seeds to increase seed vigour, seedling growth and yield. Exposure of fresh seeds of maize (*Zea mays* L.) to specific static magnetic fields enhanced germination characteristics, field emergence and reduced seed leachate conductivity (Vashisth *et al.,* 2009). Pulsed magnetic field has been found to increase the plant height, fresh weight, dry weight and protein content in soybeans (Radhakrishnan and Kumari, 2012). The use of magnetic field as a pre-sowing treatment is becoming more familiar among researchers, as it is closer to the agricultural practices.Pre-treatment of seeds with static magnetic field has been found to increase the maize seedling growth against water stress (Anand *et al*., 2012). The effects of PMF on plant growth and development have been investigated in a large number of plant species (Dayal and Singh, 1986). Vashisth and Nagarajan (2010) reported that magnetic field enhanced seed vigour by influencing the biochemical processes, which stimulate the activity of proteins and enzymes. The root length and root surface are used as important physiological parameters for evaluation of chemical elements uptake (Wang *et al.,* 2006). In the presentstudy, the effects of electromagnetic fields on maize seed have been carried out experimentally to investigate the potential of augmentation of yield components, seed germination, seedling developmental growth and quality parameters by varyingmagnetic field intensity and exposure time.

MATERIALS AND METHODS

Maize inbred, BML-6 was selected to study the effect of pulsed magnetic field on quantitative and qualitative traits. The seeds were subjected to PMF with varying frequencies of 1Hz (T_1), 10 Hz (T_2), 50 Hz(T_3) and 100 Hz(T_4) with an intensity of 1500nT for 5 hrs per day for a period of 15days to determine optimal frequency. The seeds were treated at Madras Institute of Magnetobiology, Anna Nagar, Chennai. Untreated seeds (absence of PMF) were used as control. The treated and untreated seeds were sown in randomized block design with three replications during *kharif*, 2012 at Seed Research and Technology Centre, Rajendranagar, Hyderabad. Recommended package of practice was followed to raise a healthy crop. The data was collected for 10 plants in each replication. Observations were recorded for plant population, plant height (cm), cob length (cm), cob width (cm), number of seeds row^{-1}, number of rows cob^{-1}, cob weight, 100 seed weight (g), seed yield plotkg^{-ha} and seed yield kg^{-ha}. Seed

******Corresponding author:* **Swarnalatha Devi, I.**
Seed Research and Technology Centre, PJTSAU, Rajendranagar, Hyderabad-500030

physiological parameters were studied in lab for germination (%), root length (cm), shoot length (cm) and seed vigour index. the quality parameters such as starch (%), protein (%) and oil (%) were recorded by using NMRT.

significantly different from 1 Hz treated seed while the other treatments were on par. No. of seeds row^{-1} exhibited significant differences among the treatments. 50 Hz treated seeds were significantly different from 1 Hz and control, while

Table 1. Effect of pulsed magnetic field on maize for quantitative characters

Treatment	Plant population	Plant height (cm)	Cob length (cm)	Cob width (cm)	No. of seeds row^{-1}	No. of rows cob^{-1}	Cob weight (kg)	Grain yield (kg/plot)	100 Seed weight (g)	Grain yield (kg/ha)
1Hz	119.7^{ab}	230.9^{a}	15.6^{ab}	6.2^{a}	24.2^{c}	13.9^{b}	8.2^{b}	6.7^{c}	30.3^{a}	3722.2^{c}
10 H	124.3^{a}	229.9^{a}	15.4^{ab}	6.4^{ab}	26.2^{bc}	14.5^{b}	9.2^{b}	7.5^{b}	29.7^{a}	4150.6^{bc}
50 Hz	123.7^{ab}	220.4^{a}	16.3^{a}	6.6^{a}	32.6^{a}	17.3^{a}	10.7^{a}	8.0^{a}	30.2^{a}	4445.3^{a}
100 Hz	123.7^{ab}	225.9^{a}	16.3^{a}	6.4^{ab}	30.1^{ab}	14.9^{b}	8.3^{b}	7.7^{ab}	30.1^{a}	4277.7^{ab}
Control	116.7^{b}	152.9^{b}	13.7^{c}	5.3^{c}	18.4^{d}	13.9^{b}	6.5^{c}	5.4^{d}	25.9^{b}	3000.5^{d}
SE_m	2.15	6.09	0.60	0.12	1.52	0.42	0.43	0.09	0.88	177.40
CD	7.03	19.88	1.98	0.39	4.98	1.37	1.42	0.30	2.89	578.54

Table 2.Effect of pulsed magnetic field on maize for physiological parameters

Treatment	Root Length (cm)	Shoot Length (cm)	Germination (%)	Vigour Index
1Hz	17.6^{c}	16.4^{b}	82.4^{d}	2839.6^{ab}
10 H	18.5^{b}	17.8^{a}	83.5^{c}	2991.1^{ab}
50 Hz	19.7^{a}	17.5^{a}	88.9^{a}	3307.1^{a}
100 Hz	18.8^{b}	17.7^{a}	85.5^{b}	3120.7^{ab}
Control	16.5^{d}	15.3^{c}	80.9^{e}	2572.6^{b}
SE_m	0.09	0.27	0.30	142.87
CD	0.30	0.91	0.99	465.94

Table 3. Effect of pulsed magnetic field on maize for quality parameters

Treatment	Oil (%)	Protein (%)	Starch (%)
T_1	6.0^{a}	10.2^{ab}	68.1^{c}
T_2	5.8^{a}	9.9^{b}	68.6^{b}
T_3	6.0^{a}	10.4^{a}	69.5^{a}
T_4	5.9^{a}	9.6^{a}	68.7^{b}
Control	4.8^{b}	9.6^{a}	68.6^{b}
SE_m	0.07	0.23	0.11
CD	0.23	0.77	0.36

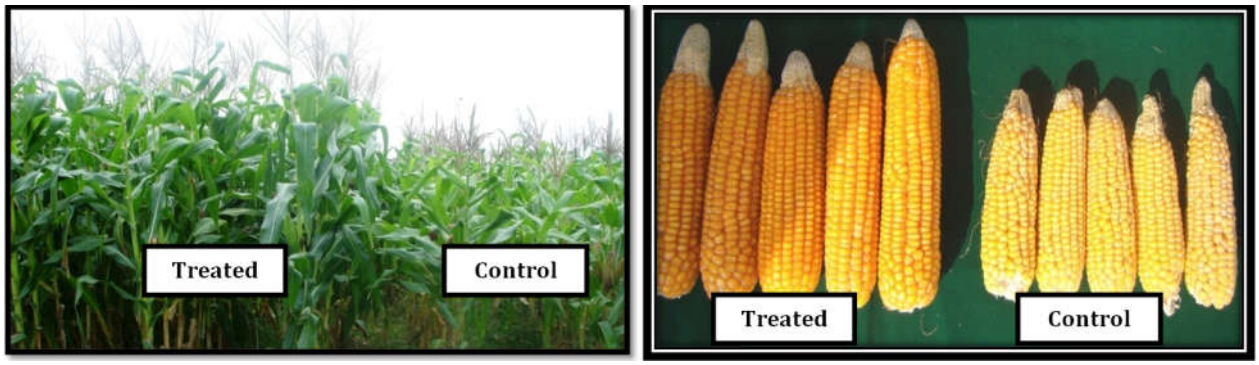

Fig. 1. Comparison of 50 HZ (T_3) exposed maize inbred (BML-6) with control

RESULTS AND DISCUSSION

Quantitative characters

The results revealed that, effect of pulsed magnetic field was significant for the traits *viz.,*plant height,cob length, cob width, No. of seedsrow^{-1}, cob weight, 100 seed weight and grain yield as compared to control (Table 1). Treatment with 50 Hz and 100 Hz have showedmaximum effect on cob length (16.3 and 16.3), cob width (6.4 and 6.6), No. of seedsrow^{-1} (32.6 and 30.1), No. of rows cob^{-1}(17.3 and 14.9) and 100 seed weight (30.2 and 30.1). The 10 Hztreated seeds were exhibited better response than 1 Hz treatment for plant population, cob width, No. of seedsrow^{-1}, No. of rows cob^{-1}, cob weight and grain yield per plot. 50 Hz treatment showed that cob width is 100 Hz and 10 Hz treatments were on par with 50 Hz. Among the treatments, 50 Hz treated seeds shown significantly maximum difference for No. of rows cob^{-1} while other treatments were on par with slight numerical differences. Among the treatments, cob weight exhibited significant difference with 50 Hz treated seeds and other treatments are on par with each other. 50 Hz treated seeds registered maximum significant effect on grain yieldkg^{-ha}when compared to 1 Hz treated and control, while the other treatments are on par. All the treatments recorded significant differences compared to control except the traits plant population and No. of rows cob^{-1}, cob length and cob width are significantly different from control. Seeds exposed to pulsed magnetic field at 50 Hz recorded maximum significant effect for most of the yield parameters studied.

Physiological parameters

Pulsed magnetic field enhancedthe seedling quality traits such as root length, shoot length, germination (%) and seed vigour index as compared to control (Table 2). Treatment with 50 Hz recorded highest root length (19.7), germination percentage (88.9 %) and seed vigour index (3367.6) followed by 100 Hz treatment. PMF enhanced the shoot length as compared to the controlwas noticed. Similar trend was observed by Ramalingam Radhakrishnan and Bollipo Dyana Ranjitha Kumari (2013). The seed germination gradually increased due to exposure of PMF from 1 Hz (82.4) to 50 Hz (88.9). However, higher dose of PMF (100 Hz) slightly declined the germination than 50 Hz, which might be due to the biochemical changes or altered enzyme activity. Similar result was observed by RamalingamRadhakrishnan and Bollipo Dyana Ranjitha Kumari (2013) in soybean and Florez *et al*. (2007) in maize.Vashisth *et al*. (2008) observed that magnetic field application enhanced the speed of germination, seedling length and seedling dry weight in chickpea.

Quality parameters

Among the treatments studied, maize seeds exposed to 1 Hz and 50 Hz have shown significantly high oil percentage (6.0) as compared other treatments (Table-3). Protein and starch percentage were high in 50 Hz treated seeds while other treatments were on par.Germination percentage exhibited highly significant differences among the treatments studied. All the treatments were on par with each other for vigour index. The results obtained in this experiment showed a positive impact of pulsed magnetic field (PMF) on quantitative, physiological parameters and quality traits. Early growth characteristics, such as root length and shoot length have been found to be promoted by magnetic fields. Aladjadjiyan, (2002) found that magnetic field of 0.15 T strength on maize samples led to an increase of shoot fresh weight by 72 % compared to the control.The exposure of maize seeds to 100 mT and 200 mT MFs for 2 hr and 1 hr led to considerable improvement in seedling growth and biological response to soil water stress of seedlings (Anjali Anand *et al.,* 2012).

Conclusion

From the study it was concluded that maize seeds pretreated with pulsed magnetic field considerably enhancing the quantitative, physiological and quality traits. Mainly it enhanced the yield and its related traits (cob length, cob width, No. of seeds row^{-1}, No. of $rowscob^{-1}$, cob weight, 100 seed weight and grain yield kg^{-ha}). Among the treatments studied 50 Hz was found to be good for most of the parameters.

Salient points for my article is

1. The pre sowing magnetic field treatment significantly enhanced the seedling length, dry and fresh mass in comparison to controls.
2. Among the various combinations of field strength, 50 Hz exposure yielded superior results.
3. The improved root length suggests that magnetically treated seeds can be used in practical agriculture where better root growth will enable extraction of moisture from deeper soil layers.

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