

## Magnetic Field Application as Pre-Sowing Seed Treatment Enhances the Seed Germination Potential of Shisham (*Dalbergia sissoo*)

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**Abstract:** The extensive use of chemicals and fertilizers is imposing drastic impacts on the society. It must be replaced by some non-chemical or biological approaches to enhance the productivity and to restore the degraded environment with a sustainable farming system. Application of magnetic field (MF) as pre-sowing seed treatment (PSST) for productivity enhancement is one of the acceptable non-chemical approaches in this regard. An experiment was designed to access the growth potential of *Dalbergia sissoo* (shisham) in response to magnetic field application as pre-sowing seed treatment. Seeds of *Dalbergia sissoo* (shisham) were treated with magnetic field of 75 mT for 5, 10, 15, 20, 25 and 30 minutes followed by seedling establishment. The experimental seeds were regularly monitored for their germination and the data regarding seed germination percentage was recorded to access the seed germination potential of *Dalbergia sissoo* as influenced by MF. The data was subjected to Regression modeling. Best fitted R<sup>2</sup> value was worked out to determine the trend of regularly emerging seedling with regard to seed germination with in the span of firstly emerging seed till last seed emerged. The plant showed high sensitivity in response to the treatment applied. The *Dalbergia sissoo* seedling responded antagonistically to the higher magnitudes of MF showing 80% to 90% mortality however, seed group treated with MF of 75 mT for 5 minutes resulted in 90% SGP with no mortality up to harvesting.

**Key words:** Shisham • Magnetic field • Seed treatment • Agroforestry • Seed germination

### INTRODUCTION

Progress of forestry is pre-requisite for stable and sustained development and growth in agriculture, industry, education, health, defense etc. Fuel wood, wood based industrial material, pulp, paper and paper products and incalculable industrial and non-industrial uses of wood are the crucial needs of our homeland, Pakistan [1].

Pakistan is spending a big share of her foreign exchange (PKR. 1.2 billion) to import the timber and other wood products in order to fulfill the day by day increasing demand of wood and fuel wood [2]. For the developing countries like Pakistan, it is not a sensible way to use such a large amount of money on import of wood and wood products. So, it is need of the time to get economic

and environmental stability by introducing such a new techniques which may be eco-friendly and economically affordable [3, 4].

The management of any problem through natural way is considered as permanent solution and safest way to tackle the situation. It has been suggested that all living components are strongly influenced by earth magnetic force [5]. Such suggestions and confirmations got attention of scientists and they tried to explore if physiological activities of plants are influenced by locally produced magnetic field (MF) as pre-sowing seed treatment (PSST). Studies about pre-sowing seed treatment of MF to test the behavior of non woody plants have been well documented and proved economically and environmentally favorable as reported by Ahmet [5],

Hozayn *et al.* [6] and chen *et al.* [7] by their work on strawberry, wheat and mung bean respectively. However research work to study the behavior to woody vegetation is still in thrust. Tanvir *et al.* [8] conducted a research to explore the growth potential of *Albizia procera* and *Leucaena leucocephala* as influenced by MF. They concluded that the low intensity MF significantly influenced plant growth. They strongly suggested extending similar type of research by including some other tree species and by using different magnitude levels of magnetic fields.

In view of the above discussion, present study is designed to determine the effect of magnetic field on seed germination percentage (SGP) of *Dalbergia sissoo* (shisham).

*Dalbergia sissoo* (shisham) is an ideal tree for timber needs after Teak wood and is considered as a king tree in Pakistan for producing high quality timber especially for furniture industry in Pakistan [1]. Its wood is being used in making veneer for plywood, small branches are used as forage as they are very palatable and delicious to ruminants. Agricultural tools, musical instruments, plywood, carvings, floorings and many other uses of *D. sissoo* are existing.

Because of diverse uses of the plant, it has become well adopted by the foresters and farmers. The unique uses of the above mentioned tree species has made the scientist to conduct the investigatory study to determine the performance of tree species as influenced by MF as PSST. In view of the above discussion the main objective of this study is to evaluate the seed germination potential of the above mentioned highly demanded commercial tree species as influenced by MF.

## MATERIALS AND METHODS

The proposed research work was initiated during the year 2013. Response of *Dalbergia sissoo* to MF application as pre-sowing seed treatment (PSST) was studied. Healthy, well ripened and uniform sized seeds of *D. sissoo* were obtained from Punjab Forestry Research Institute (PFRI), Gatwala, Pakistan. The seeds were cleaned to make them free from debris. Potting medium was prepared with sandy loam soil (taken from the upper 10 cm layer of soil in the Forest Nursery, Department of Forestry, Range Management and Wildlife, University of Agriculture, Faisalabad, Pakistan) made free from plant debris/straw and other deleterious materials, sun dried, grounded and passed through 5.0 mm strainer. Desired numbers of polythene bags (PBs) of dimensions 10 × 12

cm were filled with soil material as per experimental plan. Six numbers of PBs filled with soil were reserved for rising of experimental plants per treatment. Total number of seeds of each tree species under seven treatments with six replications were = (Number of seeds per treatment (n) × T × R = 4 × 7 × 6 = 168). Where, T stands for number of treatment and R for number of replication. The pre sowing magnetic treatments were administrated using an electromagnet device (Magnetic Seed Stimulator).

The soaked seeds were taken to the Biomagnetic Lab., Department of Physics, University of Agriculture, Faisalabad and were grouped into seven categories to treat them with MF of 75 mT for time exposure of 5 minutes (T<sub>2</sub>), 10 minutes (T<sub>3</sub>), 15 minutes (T<sub>4</sub>), 20 minutes (T<sub>5</sub>), 25 minutes (T<sub>6</sub>) and 30 minutes (T<sub>7</sub>). Non treated seeds were taken as control (T<sub>1</sub>). The seeds were placed in a petri dish on the pole of electromagnet. The above mentioned seeds of 7 groups were sown in the assigned PBs within no time to avoid the drying of absorbed seeds. Four (4) numbers of seeds of each species were put in the assigned PBs. Number of new seedling emerging from the seeds were recorded on daily base till complete germination.

Data collected from the experiment was subjected to statistical analysis using Regression modeling. Best fitted R<sup>2</sup> value was worked out to determine the trend of regularly emerging seedling with regard to seed germination with in the span of firstly emerging seed till last seed emerged. The data was also subjected towards completely randomized design (CRD) to check the significance among results.

## RESULTS AND DISCUSSION

The recorded data about seed germination percentage (SGP) in the seedlings of *Dalbergia sissoo* was statistically analyzed according to prescribed design (CRD). Various means of SGP resulted by magnetic field (MF) application (75 mT for different time intervals) to the seeds of the test species were compared and the differences among means were tested for their significance at  $p < 0.05$ . Statistical interpretation of the analyzed data is given below.

As per data recorded there was no seedling emergence in the seeds of *D. sissoo* from the first day of sowing up to the 16<sup>th</sup> day of sowing. It was the 18<sup>th</sup> day when seedling emergence was started under different pre-sowing seed treatments (PSST) of magnetic field (MF) i.e. non treated seeds (T<sub>1</sub>), seeds treated with MF for 5 minutes (T<sub>2</sub>) seeds treated with MF for 10 minutes (T<sub>3</sub>),

seeds treated with MF for 15 minutes (T<sub>4</sub>) seeds treated with MF for 20 minutes (T<sub>5</sub>), seeds treated with MF for 25 minutes (T<sub>6</sub>) and seeds treated with MF for 30 minutes (T<sub>7</sub>).

For graphical representation seed germination percentage (SGP) of *D. sissoo* as influenced by MF we spent 10 observations to record SGP started from 2 days before 1<sup>st</sup> seedling emergence (that was sixteenth day of sowing with 0% SGP) till the day of final emergence of seedlings under different treatments of MF as PSST (10<sup>th</sup> observation was taken on 34<sup>th</sup> day).

According to the 3<sup>rd</sup> observation which was recorded on 20<sup>th</sup> day the results were like this, seeds of T<sub>1</sub> had 15% SGP (Figure and Table 1, T<sub>1</sub>), seeds of T<sub>2</sub> had the highest SGP of 80% (Fig.1 and Table 1, T<sub>2</sub>). SGP in the rest of treatments were found in minimum value in T<sub>1</sub> and maximum value in T<sub>2</sub>. T<sub>3</sub> had the SGP of 25% (Fig.1 and Table 1, T<sub>3</sub>), T<sub>4</sub> had the SGP of 20% (Fig.1 and Table 1, T<sub>4</sub>), T<sub>5</sub> had the SGP of 40% (Fig.1 and Table 1, T<sub>5</sub>), T<sub>6</sub> had the SGP of 30% (Fig.1 and Table 1, T<sub>6</sub>) and T<sub>7</sub> had the SGP of 50% (Fig.1 and Table 1, T<sub>7</sub>).

Table 1: Level of significance among means showing seed germination potential in *Dalbergia sissoo* as influenced by magnetic field as PSST.

Treatment	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>	T <sub>7</sub>	Error	HSD-Value	F- v ale	P-value	CV
Mean value	11 b	22 a	5 c	4 cd	3 de		2e	0.46	1.45	464	0.000	10.76
SGP	45%	90%	20%	20%	16%	10%	10%					

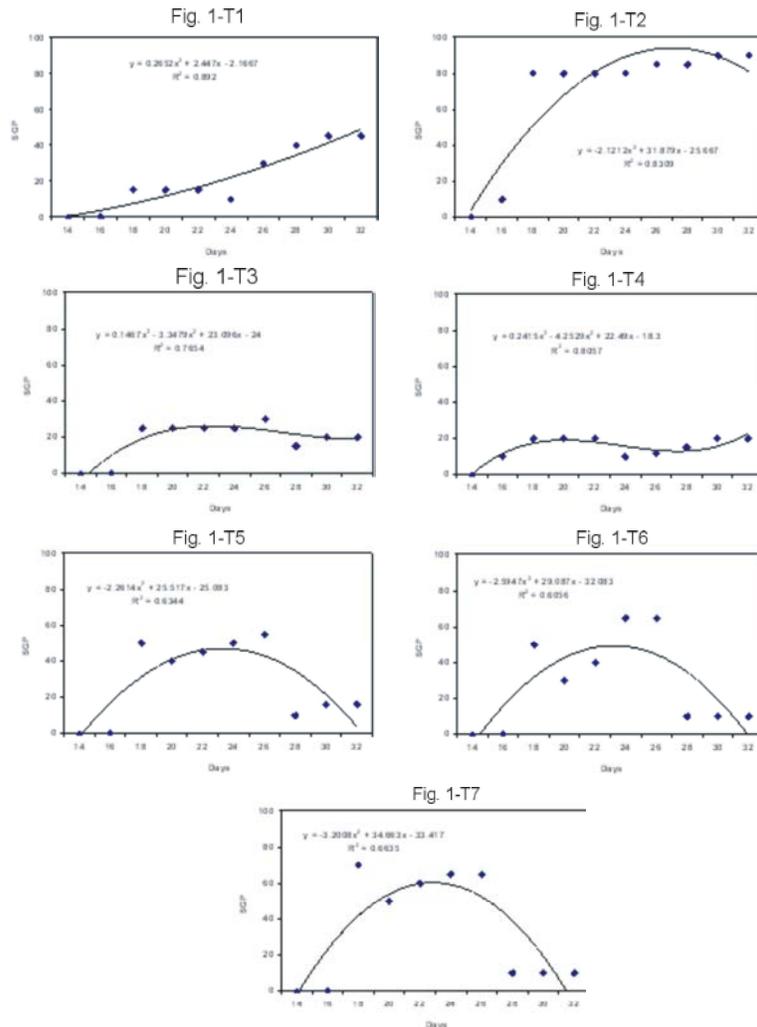


Fig 1: Seed Germination Percentage (SGP) of *D. sissoo* as influenced by MF of 75 mT for non-treated seeds (T<sub>1</sub>), seeds treated with MF for 5 minutes (T<sub>2</sub>), for 10 minutes (T<sub>3</sub>), for 15 minutes (T<sub>4</sub>), for 20 minutes (T<sub>5</sub>), for 25 minutes (T<sub>6</sub>) and for 30 minutes (T<sub>7</sub>).

As per data recorded in the 4<sup>th</sup> observation, it was noticed that at 22<sup>nd</sup> day of sowing seeds of T<sub>1</sub> had the 15% SGP whereas T<sub>2</sub> had the highest SGP of 80%. SGP in the rest of seed groups of various treatments such as T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub> and T<sub>7</sub> was 25 %, 20%, 40%, 60% and 70% respectively.

The results noted in 5<sup>th</sup> observation showed that SGP of T<sub>1</sub> seeds were decreased from 15% to 10% because of 5% mortality. Recording for the seeds of treatment T<sub>2</sub> were similar as mentioned in 4<sup>th</sup> observation, in detail i.e. 80%. T<sub>3</sub> was with 25% SGP, T<sub>4</sub> had also faced 50% mortality and got their SGP decreased up to 10% from 20%, T<sub>5</sub> was with 50% SGP and T<sub>6</sub> and T<sub>7</sub> both were together with 65% SGP.

According to the 6<sup>th</sup> observation T<sub>1</sub> was with SGP of 30%, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub> and T<sub>7</sub> were with the SGP of 85%, 30%, 12%, 55%, 65% and 65% respectively.

As by the 7<sup>th</sup> observation T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub> and T<sub>7</sub> were with the SGP of 45%, 90%, 20%, 20%, 16%, 10% and 10% respectively.

For the 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> observations the results were constant.

It is worth mentioning that *D. sissoo* attained maximum SGP increment with in 1<sup>st</sup> 20 days of sowing (up to 3<sup>rd</sup> observation) suggesting that the seeds which are potentially able to flourish in favourable conditions are ready to germinate within one week after its emergence of seedling.

Secondly, the seeds of T<sub>2</sub> strongly influenced the seed health as seedling under all treatments of MF had faced significant mortality except in T<sub>2</sub>. This suggested that the seeds if *D. sissoo* are sensitive to Mf application. Seeds of T<sub>2</sub> when applied with 75 mT for least time interval (5 minutes) responded positively with no seedling mortality. On the other hand, seedlings in other treatments (except T<sub>2</sub>) responded antagonistically with significant seedling mortality as influenced by MF application for greater time interval (> 5 minutes).

Thirdly treatment T<sub>2</sub> had resulted in highest SGP (90%) followed by T<sub>1</sub> (50%). Other treatments resulted in SGP < 20%.

Proper seed germination is the basic requirement for normal growth, increased development and ideal yield of crops.

Seeds of *D. sissoo* treated with MF for longer time intervals resulted in decreased SGP. For instance, the highest SGP was recorded in the seeds of *D. sissoo* when treated with 75 mT MF for 5 minutes (T<sub>2</sub>), further increase in time interval for PSST resulted in decreased germination.

In other study, Tanvir *et al.* [8] worked on *Albizia procera* and *Leucaena leucocephala* and discovered 49.0% and 37.0% more germination than in the control, respectively when the seeds were exposed to a MF of same magnitude i.e. 75 mT for 15 minutes probably the seeds which [8] were dealing with, was having seed coat thicker than the seed coat of *Dalbergia sissoo*, which resulted in ideal SGP after having treatment for 5 minutes only. Electromagnetic irradiation applied as pre-sowing treatment increases corn seed vigour through emergence rate, establishment percentage, and dry mass of seedling aerial part, according to the combination of radiation intensity, time and the genotype [9]. The influence of magnetic field treatment on tobacco seeds germination has been found to be dependent upon strength of magnetic field and exposure time [10]. Studies showed that the influence of the stationary magnetic field on the seeds increased the germination of non-standard seeds and improved their quality [11].

As reported by the above mentioned research scholars our study also depict that magnetic field has positive effect on the seed germination. We found 90% more germination as compared to the controlled. Other workers Choudhary *et al.* [12], Carbonell *et al.* [13], Shabrangi & Majd [14] and Mercedes *et al.* [15] supported the same idea that the low frequency MF enhances the germination rate and percentage.

## CONCLUSION

Conclusively we can say that the plant is highly sensitive to the time interval of treatment (MF) application because all the treatments had shown mortality except T<sub>2</sub>, Fig. 1.1 also supports our results.

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