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INVIGORATION OF *DATURA STRAMONIUM* SEEDS BY MAGNETIC FIELD TREATMENT

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ABSTRACT

In order to study effect of Seed priming has been reported to enhance growth of plants. To evaluate the effect of some physical seed priming materials (ultrasonic, gamma, beta and laser irradiation, magnetic field and hydro-priming) on seed germination and growth of *Datura stramonium* a laboratory experiment was conducted at Islamic Azad University of Tabriz branch, using completely randomized design, with three replicates. The results revealed that the highest germination rate was due to seed treatment by gamma irradiation. Lowest germination rate belonged to beta irradiation treatments and ultrasonic irradiation. Highest seedling dry weight belonged seed treatments by gamma irradiation and magnetic field for 15 min. respectively. Highest seedling vigor index was obtained when seeds primed with gamma irradiation and lowest from beta irradiation seed treatment. It may be concluded that tomato producers could improve seed germination percent by priming the seed with magnetic field for 15 minutes.

Keywords: *Beta Irradiation, Datura stramonium, Gamma Irradiation, Magnetic Field*

INTRODUCTION

Datura stramonium is a wild-growing herb, known as Jimsonweed. It also has several other names: thorn apple, angel's trumpet, loco weed, etc. The incidence of *D. stramonium* poisoning is sporadic with a cluster of poisoning cases occurring mostly among adolescents. Some medicinal uses of the plant are its antiinflammatory property of all part of the plants, stimulation of the central nervous system (CNS), respiratory decongestion, treatment of dental and skin infections and also in the treatment of toothache and alopecia (Maibam *et al.*, 2011). Germination and seedling establishment are critical stages in the plant life cycle (Ganji *et al.*, 2011). Pre-sowing hydration treatments (priming) include non-controlled water uptake systems (methods in which water is freely available and not restricted by the environment) and controlled systems (methods that regulate seed moisture content preventing the completion of germination).

There are several indications that many physiological mechanisms are involved in seed priming such as the repair of the age related cellular and subcellular damage that can accumulate during seed development (Bray, 1995; Burgass and Powell 1984) and an advancement of metabolic events of imbibition that prepare the radicle protrusion (Dell'aquila and Beweley, 1989).

The magnetic stimulation of the wheat seeds resulted in acceleration of the process of germination. Although magnetic fields speed up seed germination and plant growth, the intensity of the applied magnetic fields and the time of seed exposure, however, vary greatly (Pietruszewski and Kania, 2010). Gamma rays belong to ionizing radiation and are the most energetic form of such electromagnetic radiation. It has an energy level of around 10 kilo electron volts (keV) to several hundred keV. Therefore, they are more penetrating than other types of radiation such as alpha and beta rays (Kova'cs and Keresztes, 2002).

In other research by Silvia neam and Marariu (2005) magnetic field treatment (120mT) with duration of 5 and 10 min on tomato seed caused meaningful increase in radicle and plumule length, leaf area, and dry weight. In order to obtain the highest crop potential in yield and/or quality, seeds of high quality that produce rapid and uniform seedling emergence are required (Artola *et al.*, 2003). The main objective of this study was to i nvigoration of *Datura stramonium* seeds by magnetic field treatment the effects of some biophysical seed treatments on seed germination and early growth of *Datura stramonium*.

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MATERIALS AND METHODS

The experiment was conducted at Islamic Azad University, Tabriz branch, using a completely randomized design with three replications during 2011 growing season. *Datura stramonium* seeds, with 73% viability, were differently treated by ultrasonication for 10 minutes (Yaldagard and Mortazavi, 2008), laser irradiation (Mohammadi *et al.*, 2012) for 5, 10 and 15 minutes, magnetic field for 5, 10 and 15 minutes (Iqbal *et al.*, 2012), gamma irradiation for 10 minutes (Farahvash *et al.*, 2007), beta irradiation for 10 minutes (Bradford, 2000), and hydro-priming for 24 hours (Artola *et al.*, 2003). Prior to planting, the seeds were surface sterilized with NaOCL 5% (Sodium hypo chloride) for 5 minutes to avoid fungal invasion and then washed immediately with distilled water. Petri dishes and filter papers were also disinfected by NaOCL and UV radiation for 24 hours in a sterile hood before their incubations. For each of 9 physical treatment techniques twenty five treated seeds were placed in 9-cm Petri dishes and then incubated in a germinator with 20 °C temperature for 14 days. Two days after incubation, seeds germinated (having radicle length of at least 5 mm.) were counted daily for 14 days.

Traits measured in the laboratory were germination percentage, seedling dry weight, and germination rate and vigor index. Analysis of variance of data collected was made by the software MSTAT-C, graphs were drawn with excel software, and means of traits were compared by using LSD test at 5% probability level.

RESULTS AND DISCUSSION

Seed Germination Percentage

Analysis of variance of the data on seed germination is depicted in Table 1. It shows that seed primings affected this trait at 1% level of probability. Mean comparisons for germination percentage also revealed that seeds treated with gamma irradiation resulted in higher germination percentage of (83%). Lowest germination percentages (44%) were observed for exposure of seeds to ultrasonic. Treating seeds with magnetic field for 5 minutes increased germination percentage by over 75%. Correlation of germination percentage with vigor index was significantly positive at 1% level of probability (Table 2). Soltani *et al.*, (2006 a and b) suggested that magnetic field treatment of seed had a positive effect on seed germination and seedling growth of asparagus (*Asparagus officinalis*) and basil (*Ocimum Basilicum*). Vashisth and Nagarajan (2010) reported that rate and speed of seed germination of sunflower, treated with magnetic fields of 50 and 250 MT for 1 hour, were increased by 5% and 9% respectively. Similar results presented by Fischer *et al.*, (2004) on sunflower. Studies showed that the influence of the stationary magnetic field on the seeds increased the germination of non-standard seeds and improved their quality (Galland and Pazur, 2005).

Chaudhuri (2002) reported that in higher radiation dose, germination percentage reduced in addition to root and shoot length, while, in lower dose i.e., 0.1 kGy the germination percentage was not significantly different from control. In another study by Kiong *et al.*, (2008), it was found that radiation increases plant sensitivity to gamma rays and this may be caused by the reduced amount of endogenous growth regulators, especially the cytokines, as a result of breakdown, or lack of synthesis, due to radiation.

Seedling Dry Weight

Analysis of variance of the traits studied is depicted in Table 1. It shows that seed primings affected seedling dry weight at 1% level of probability. Comparison of means indicated that highest seedling dry weight belonged seed treatments by gamma irradiation (9.33 mg) and magnetic field for 15 min. (8.70 mg) respectively.

Lowest seedling dry weight was obtained when seed primed by beta irradiation (1.16 mg). treated by seedling dry weight when seed magnetic field for 5 min. (6.83 mg) and magnetic field for 10 min (8.16 mg), laser 5 min (7.06 mg) and control (4.93) (Table 2). However, seedling dry weight of the seeds treated by ultrasonic irradiation was 3.63 mg, by laser irradiation for 10 min. was 0.35 cm6.06 mg, by laser for 15 min. was 2.46 mg, hydropriming was (5.16 mg) and control was 4.93 mg. Seedling dry weight was highly correlated, germination percentage and vigor index (Table 3). In other research by Silvia neam and Marariu (2005) magnetic field treatment (120mT) with duration of 5 and 10 min. on tomato seed caused meaningful increase in radicle and plumule length, leaf area, and dry weight.

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Germination Rate

Physical seed treatments also affected germination rate significantly at 1% level of probability (Table 1). Mean comparisons indicated that highest germination rate (6.10 day^{-1}) was due to seed treatment by gamma irradiation. Lowest germination rate belonged to beta irradiation treatments (2.03 day^{-1}) and ultrasonic irradiation (2.76 day^{-1}). Germination rate as to the other treatments 5.54 day^{-1} for magnetic field 10 min., 6.10 day^{-1} for gamma irradiation and hydropriming, 4.88 day^{-1} for magnetic field 5 min. and 5.11 day^{-1} . Correlations of germination rate with germination percentage, vigor index were positive and significant at 1% levels of probability (Table 3). Changes in the germination percentage were found to attribute to gamma rays treatments. The stimulating causes of gamma ray on germination may be certified to the activation of RNA or protein synthesis, which occurred during the early stage of germination after seeds irradiated (Abdel-Hady *et al.*, 2008). Although, no certain explanations for the stimulatory effects of low-dose gamma radiation are available until now, in accordance to the results obtained by Wi *et al.*, (2007), there is a hypothesis that the low dose irradiation will induce the growth stimulation by changing the hormonal signaling network in plant cells or by increasing the anti oxidative capacity of the cells to easily overcome daily stress factors such as fluctuations of light intensity and temperature in the growth condition (Wi *et al.*, 2007). In a study of the gamma radiation effects on chickpea seeds by Toker *et al.*, (2005) seedlings irradiated at 200 Gy may have some significant increase in their shoot length, but at 400 Gy an obvious depression in shoot length was observed.

Vigor Index

Analysis of variance showed that the effects of seed priming agents on vigor index of *Datura stramonium* was significant that at 1% level of probability (Table 1). Comparison of means (Table 2) indicated that priming of *Datura stramonium* seed with gamma irradiation for 10 min. increased seedling vigor index by 124% against control. Highest seedling vigor index was obtained when seeds primed with gamma irradiation (774.4), and lowest from beta irradiation seed treatment (58.67).

Table 1: Variance analysis of traits under study as affected by physical seed priming techniques

SOV	df	Germination (%)	Seedling dry weight	Germination rate	Vigor index (SVI) (mg)
Treatment	10	435**	20.29 **	4.85 **	153475.59 **
Error	22	44.90	0.74	0.26	4120.70
C.V (%)	-	10.43	14.98	11.15	16.20

** , means significant at 1% levels of probability.

Table 2: Comparison of means effects of physical seed priming on some traits in *Datura stramonium* in laboratory

Priming Agents and Duration of Exposure	Germination (%)	Seedling dry weight (mg)	Germination rate	Vigor index (SVI) (mg)
magnetic field 5 minutes	75	6.83	5.11	510
magnetic field 10 minutes	73.67	8.16	5.54	601.8
magnetic field 15 minutes	73	8.70	5.55	635.3
Laser 5 minutes	63.67	7.06	5.37	450.6
Laser 10 minutes	65	6.06	4.88	392.8
Laser 15 minutes	52.33	2.46	3.56	130.3
Gamma 10 minutes	83	9.33	6.10	774.4
Ultrasonic 10 minutes	44	3.63	2.76	157.3
Beta 10 minutes	50	1.16	2.03	58.67
Hydro-priming 24 hours	58	5.16	4.88	302.1
Control	69	4.93	4.86	344.4
LSD 5%	11.35	1.46	0.86	108.7

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Vigor index of seed priming with laser irradiation 15 min., magnetic field for 5 min. and magnetic field for 10 min. were 130.3, 510, 601.8 and respectively.

Table 3: Correlation between traits of study in laboratory in *Datura stramonium*

	Germination (%)	Seedling dry weight	dry	Germination rate	Vigor (SVI)	index
Germination (%)	1					
Seedling dry weight	0.76**	1				
Germination rate	0.74**	0.82**		1		
Vigor index (SVI)	0.87**	0.97**		0.82**	1	

** , means significant at 1% and 5% probability levels.

Norfadzrin *et al.*, (2007) showed that tomato and okra seeds irradiated by gamma rays, affected their better growth of seedlings. Treating seeds with gamma irradiation may result in a significant increase in seedling length and vigor.

Conclusion

Based on the results obtained from this study it can be concluded that treating datura seeds by magnetic field increases its growth and early growth more than other irradiation agents used. Additional investigations are needed to warrant the preferability of magnetic field priming of datura seed over other seed priming agents.

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