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Barley (*Hordeum vulgare*) yield as affected by exposure time under physical priming techniques

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Key words: Cultivation area, exposure time, vigorous seedlings.

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Abstract

This study aimed to evaluate the effects of exposure time of physical priming methods on barley (*Hordeum vulgare*) yield. The seeds were treated by ultrasonication, laser irradiation, magnetic field, gamma and beta irradiations all for 5 and 10 min. of exposure time. Analysis of variance of data collected was made by the software MSTAT-C, and means of traits were compared by using least significant difference test at 5% probability level. Time to final germination ranged from 5 days in laser and magnetic field treatments at 5 min. exposure time. Those barley seeds treated with magnetic field and gamma treatments for 5 min. completely germinated, but only 85% of seeds under beta irradiation germinated. The vigorous barley seedlings with higher dry weight obtained from seeds under laser and magnetic field treatments at 5 min. exposure time. Materials under magnetic field treatment at 5, 10 min. and laser at 5, 10 min. produced seeds with TSW of nearly 46 g and 41 g, respectively. Seed yield ranged from 372 g m^{-2} in magnetic field treatment at 5 min. exposure time up to 284 g m^{-2} in beta irradiations. It can be concluded that treating barley seeds with magnetic field increases grain yield.

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Introduction

Barley (*Hordeum vulgare* L.), a member of the grass family, is a major cereal grain. It was one of the first cultivated grains and is now grown widely. Barley has also been used as animal fodder, as a source of fermentable material for beer and certain distilled beverages, and as a component of various health foods. It is used in soups and stews, and in barley bread of various cultures. Barley grains are commonly made into malt in a traditional and ancient method of preparation. In a 2012 ranking of cereal crops in the world, barley was fourth both in terms of quantity produced (136 million tons) and in area of cultivation (566,000 km^2) (FAO, 2012).

Seed priming has been shown to enhancing seed germination speed (Ryan and Young, 2006), decreasing time between sowing and emergence and improving seedling vigour (Harris, 1996), better stand establishment (Arif *et al.*, 2005; Ali *et al.*, 2007; Diniz *et al.*, 2009) and increasing yield (Rengel and Graham 1995a, b; Yilmaz *et al.*, 1998).

Germination rate as well as growth of crop plants can be improved by physical irradiations (Marks and Szecówka, 2010). Farooq *et al.* (2008) conducted a study to explore the possibility of yield improving in late sown wheat crop by seed priming. Vashisth and Nagarajan (2008, 2010) emphasized the positive effects of seeds exposed to static magnetic field for improvement of maize, chickpea and sunflower growth. There are a little information about effect of physical methods priming techniques on cereal crops.This study aimed to evaluate the effects of exposure time of physical priming methods on barley yield.

Materials and methods

Cultivation details

Field experiment was conducted at the Islamic Azad University, Tabriz Branch, Iran, factorially in a randomized complete block design with three replications on barley (*Hordeum vulgare* cv. Bahman) during 2012.

Based on soil analysis field was fertilized with 90 kg ha^{-1} urea, 30 kg ha^{-1} P_2O_5 and 30 kg ha^{-1} K_2O. The seeds were treated by ultrasonication, laser irradiation, magnetic field, gamma and beta irradiations all for 5 and 10 min. of exposure times. Irrigation times adjusted based on 90 mm evaporation from pan.

Statistical analysis

Analysis of variance of data collected was made by the software MSTAT-C, and means of traits were compared by using least significant difference test at 5% probability level.

Results and discussion

Greenhouse experiment

Variance analysis

Variance analysis of effect of physical priming on barley germination characteristics (Table 1) indicated that time to final germination; final germination percentage and seedling dry weight of barley affected by studied treatments at 5% probability level.

Table 1. Variance analysis of effect of physical priming on barley germination characteristics.

SOV	df	Time to final germination	Final germination Percentage	Seedling dry weight	Seedling vigor index
		Mean squares			
Treatment	10	651.55*	52100.00*	39.58*	145148.22
Error	22	196.17	14918.40	8.91	21650.88
CV (5%)	-	21.28	13.00	28.50	14.82

*means significant difference at 5% probability level.

Mean comparison

Time to final germination ranged from 5 days in laser and magnetic field treatments at 5 min. exposure time.

Those barley seeds treated with magnetic field and gamma treatments for 5 min. completely germinated, but only 85% of seeds under beta irradiation germinated. The vigorous barley seedlings with higher dry weight obtained from seeds under laser and magnetic field treatments at 5 min. exposure time.

Table 2. Mean comparisons of effect of physical priming on barley germination characteristics.

Treatment	Time to final germination (day)	Final germination percentage	Seedling dry weight (g plant^{-1})	Seedling vigor index
Ultrasonication 5 min.	7.7	90	0.93	83.7
Ultrasonication 10 min.	8.2	88.5	0.93	82.3
Laser 5 min.	5.0	98	1.21	118.6
Laser 10 min.	6.5	98	1.10	107.8
Magnetic field 5 min.	5.0	100	1.30	130
Magnetic field 10 min.	6.3	99	1.14	112.9
Gamma 5 min.	6.2	100	1.16	116
Gamma 10 min.	6.2	98	1.16	113.7
Beta 5 min.	7.5	85	0.84	71.4
Beta 10 min.	7.5	85	0.75	63.8
Control	6.3	92	1.0	92
LSD (5%)	0.86	5.0	0.14	18.5

In recent years, a lot of work has been done on the invigoration of seeds to improve the germination rate and uniformity of growth and reduce the emergence time of some field crops (Basra *et al.*, 2003). Rapid and uniform field emergence is two essential prerequisites to increase yield, quality and ultimately profits in annual crops (Parera and Cantliffe, 2005).

Table 3. Variance analysis of effect of physical priming on barley growth attributes and yield.

SOV	df	Chlorophyle content index	Thousand seed weight	Seed yield
		Mean squares		
Block	2	145.25	4512789.25	479.73
Treatment	10	17148.00*	54000.09*	403379.33*
Error	20	3451.61	9593.96	80912.03
CV (5%)	-	31.22	24.82	8.58

* means significant difference at 5% probability level.

Field experiment

Variance analysis

Variance analysis of effect of physical priming on barley growth attributes and yield (Table 3) indicated that chlorophyle content index; thousand seed weight (TSW) and seed yield affected by studied treatments at 5% probability level.

Mean comparison

Leaves from laser at 5 min. and magnetic field treatments at 5, 10 min. exposure times had higher chlorophyle content index. Materials under magnetic field treatment at 5, 10 min. and laser at 5, 10 min. produced seeds with TSW of nearly 46 g and 41 g, respectively.

Fischer *et al.* (2004) by stimulating sunflower seeds with magnetic field induction of 20 µT and 16 Hz.

frequency, obtained an increased seeds weight and plant height.

Seed yield ranged from 372 g m^{-2} in magnetic field treatment at 5 min. exposure time up to 284 g m^{-2} in beta irradiations.

This result is in conformity with those of Alajadjiyan and Ylieva (2003), Atak *et al.* (2003) and Vasilevski (2003) who emphasized that seed priming would affect speed and percent of seed germination, and finally seed yield in several crop plants. They also concluded that better results may depend upon the combine effect of appropriate magnetic field strength and exposure time.

Table 4. Mean comparisons of effect of physical priming on barley growth attributes and yield.

Treatment	Chlorophyle content index	Thousand seed weight (g)	Seed yield (g m^{-2})
Ultrasonication 5 min.	17.5	34	315
Ultrasonication 10 min.	15	32.5	300
Laser 5 min.	21.6	40.4	343
Laser 10 min.	20	41	340
Magnetic field 5 min.	25.5	48	372
Magnetic field 10 min.	25	44.3	364
Gamma 5 min.	17	42	365
Gamma 10 min.	17	42	333
Beta 5 min.	16	36	287
Beta 10 min.	16.4	36	280
Control	16	37.9	309.8
LSD (5%)	2.03	4.2	21.4

Conclusion

It can be concluded that treating barley seeds with magnetic field increase grain yield.

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References

Aladjadjiyan A, Ylieva T. 2003. Influence of stationary magnetic field on the early stages of the development of tobacco seeds (*Nicotiana tabacum* L.). Journal of Central European Agriculture **4,** 131-135.

Ali S, Arif M, Gul R, Khan A, Shah SS, Ali I. 2007. Improving maize seed emergence and early seedling growth through water soaking. Scientific Khyber **19,** 173-177.

Arif M, Ali S, Shah A, Javed N, Rashid A. 2005. Seed priming maize for improving emergence and seedling growth. Sarhad Journal of Agriculture **21,** 539-543.
http://dx.doi.org/10.1631/jzus

Atak C, Emiroglu O, Alikamanoglu S, Rzakoulieva A. 2003. Stimulation of regeneration by magnetic field in soybean (*Glycine max* L. Merrill) tissue cultures. Journal of Cell and Molecular Biology **2,** 113-119.
http://dx.doi.org/10.1351/PAC-CON-08-10-18

Basra SMA, Zia MN, Mehmood T, Afzal I, Khaliq A. 2003. Comparison of different invigoration techniques in wheat (*Triticum aestivum* L.) seeds. Pakistan Journal of Arid Agriculture **5**, 11–6.

Diniz KA, Silva PA, Oliveira JA, Evangelista JRE. 2009. Sweet pepper seed responses to inoculation with microorganisms and coating with micronutrients, amino acids and plant growth regulators. Science and Agriculture **66 (3),** 293-297. http://dx.doi.org/10.1590/S010390162009000300002

FAOSTAT. 2012. Food and Agriculture Organization of the United Nations.

Farooq M, Basra SMA, Rehman H, Saleem B. 2008. Seed priming enhances the performance of late sown wheat (*Triticum aestivum* L.) by improving chilling tolerance. Journal of Agronomy and Crop Science **194(1),** 55-60. http://dx.doi.org/10.5539/jas.v4n9p256

Harris D. 1996. The effects of manure, genotype, seed priming, depth and date of sowing on the emergence and early growth of *Sorghum bicolor* (L.) Moench in semi-arid Botswana. Soil and Tillage Research **40,** 73-88. http://dx.doi.org/10.4067/S0718583920120001000015

Marks N, Szecówka PS. 2010. Impact of variable magnetic field stimulation on growth of aboveground parts of potato plants. International Agrophysics **24,** 165-170.

Parera CA, Cantliffe D. 2005. Pre-sowing Seed Priming. Horticultural Sciences Department, University of Florida.

Rengel Z, Graham RD. 1995. Importance of seed Zn content for wheat grown on Zn-deficient soil I. Vegetative growth. Plant and Soil **173,** 259–266.

Ryan HD, Young TP. 2006. Germination speeds of exotic annual and native perennial grasses in California and the potential benefits of seed priming for grassland restoration. California Native Grasslands Association **16(1),** 14-17. http://dx.doi.org/10.12692/ijb/3.6.32-37

Vashisth A, Nagarajan S. 2010. Improved germination and growth characteristics in sunflower (*Helianthus annuus*) seeds exposed to static magnetic field. Journal of Plant Physiology **167,** 149-156.

Vasilevski G. 2003. Perspectives of the application of biophysical methods in sustainable agriculture. Bulgarian Journal of Plant Physiology Special Issue 179-186. http://dx.doi.org/10.1016/B978-0-12-384719-5.00335-X. 372

Yilmaz A, Ekiz H, Gultekin I, Torun B, Barut H, Karanlik S, Cakmak I. 1998. Effect of seed zinc content on grain yield and zinc concentration of wheat grown in zinc-deficient calcareous soils. Journal of Plant Nutrition **21,** 2257-2264. http://dx.doi.org/10.1080/01904169809365559