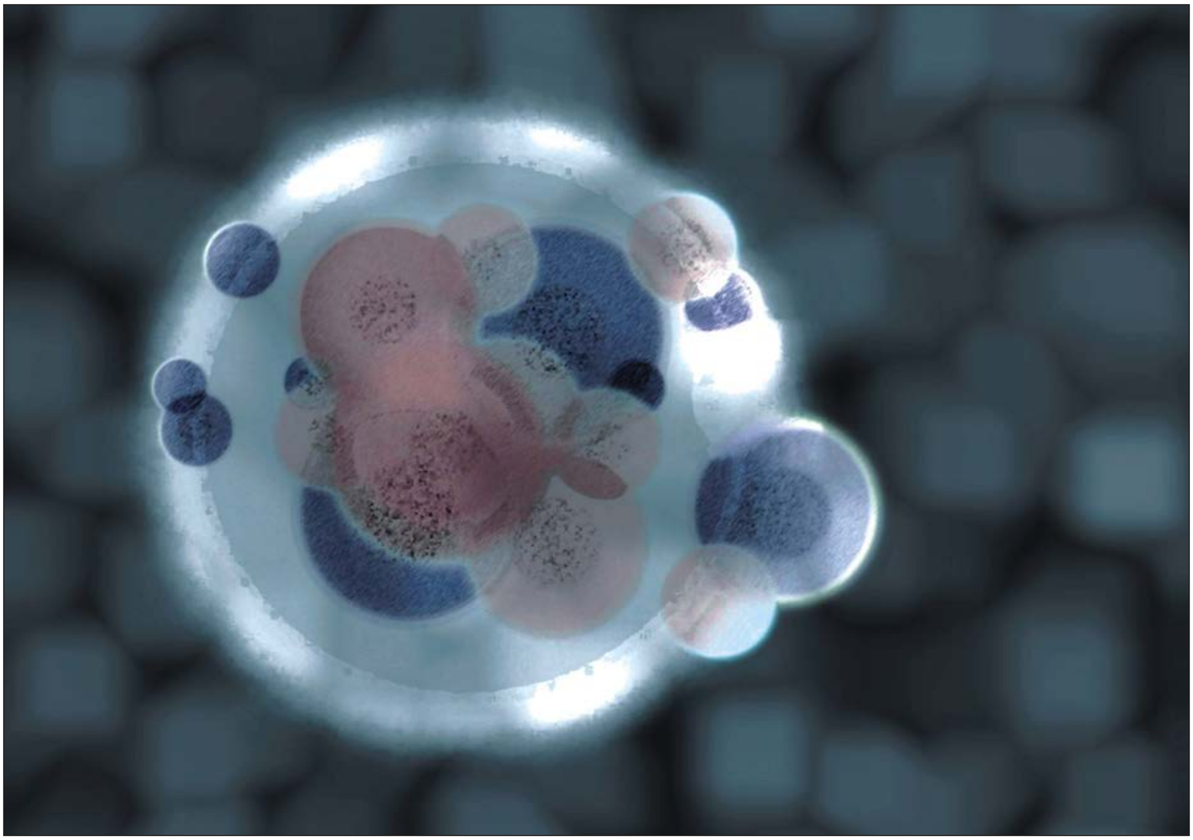

Journal of Biological Sciences

ISSN 1727-3048

Journal of Biological Sciences 14 (8): 532-536, 2014
ISSN 1727-3048

ansinet
Asian Network for Scientific Information

RESEARCH ARTICLE OPEN ACCESS

DOI: 10.3923/jbs.2014.532.536

Effect of Different Harvesting Times on the Seed Quality of Barley Cultivars

[1]Hassan Mohtadi Ilkhani Zadeh, [1]Tooraj Mir Mahmoodi and [2]Nabi Khaliliaqdam
[1]Department of Agronomy and Plant Breeding, Mahabad Branch, Islamic Azad University, Mahabad, Iran
[2]Department of Agriculture, Payame Noor University, Saghez, Iran

ARTICLE INFO
Article History:
Received: October 13, 2014
Accepted: January 20, 2015

Corresponding Author:
Nabi Khaliliaqdam,
Department of Agriculture,
Payame Noor University, Saghez, Iran

ABSTRACT
The present study aimed to evaluate the effect of different harvesting times on the quality of barley seed cultivars and to identify the best and most suitable barley harvesting stage for producing the most desirable seeds. To do so, a factorial experiment in a completely randomized block design with four replications was undertaken. The experimental factorials included six barley cultivars (Makoee, Dide, ADC-1, Bahman, Yusef and ADC-20) and 10 harvesting time stages (211 days after emergence and one harvest every 5 days up to 256 days after emergence). All six cultivars were concurrently cultivated in 2011 and two irrigations were performed for the initial emergence. The attributes to be studied were thousand-seed weight, seedling dry weight, seed vigour index, mean germination time, germination rate, percentage of viable seeds and electrical conductivity. The results indicated that the effects of different harvesting times and cultivar effect on all studied characteristics (thousand-seed weight, seedling dry weight, seed vigour index, mean germination time, germination rate, percentage of viable seeds and electrical conductivity) were significant ($p<0.05$). Most of the cultivars reached the maximum germination and seedling growth rate 241 days after emergence. Furthermore, the results highlighted the significance of the reciprocal effect of harvesting time×cultivar on electrical conductivity and thousand-seed weight. In general, the results suggested that the best harvesting time in most cultivars was the seventh harvest (241 days after emergence). In addition, electrical connectivity and thousand-seed weight could be utilized as useful indexes for determining the harvesting time.

Key words: Barley cultivars, harvesting times, seed quality

INTRODUCTION

Barley, an annual plant, has played an important role in the domestic diets of Iranians (Maleki *et al*., 2009; Al-Karaki *et al*., 2007; Kouchaki, 2004). After wheat, rice and sweet corn, barley is the fourth most important grain in the world (Fathi, 2001). Barley is used as a food for humans and domesticated animals as well as for producing malt (Poorsaleh, 1994).

Grains are good sources of nutrients and energy and a source of hydrocarbon materials for humans. About 55% of lipids, 70% of glucose and altogether 50 to 55% of calories used by humans globally are provided through grains (Mohamadi *et al*., 2008). Along side the world's growing population, the need for food has also increased, thus increasing agricultural yields is of primary importance. To achieve high agronomical performance, two factors can be applied: Increasing acreage and improving yields per unit area. For increasing yields per unit area, genetic aspects, improving agricultural operations and protecting against pests, diseases and weeds are influencing factors (Briggle and Cutis, 1987). Some characteristics are linked with quality are important means of reformatory programme and they riddle a lot of genotypes (Cornish *et al*., 2001). Using low quality seeds in farming can lead to yield loss per unit area due to a reduction in seedling percentage and seedling emergence rate (Ghassemi-Golezani *et al*., 1996). Given the significant effects of seed quality on final yield, the investigation and identification of appropriate methods for producing high-quality seeds is currently more necessary than ever.

Moreover, investigation and identification of a growth and ripeness stage in which seeds quality and value reaches its utmost is of crucial importance in agriculture (Perry, 1981).

MATERIALS AND METHODS

This study was conducted as factorial in a completely randomized block design, with four replications and six treating compounds at Miandoab Agricultural Research Station (latitude 46°6', longitude 36°58', altitude 1124 m asl). Experimental factors consisted of six cultivars at six levels (Bahman, Makoee, Dide, Yusef, ADC-1 and ADC-20), a seed harvesting stage as the second factor was carried out at 10 levels (from 211 days after emergence and at 5 day intervals until 256 days after emergence). The traits under study within each sampling were thousand-seed weight, seedling dry weight, seed vigour index, mean germination time, germination rate, viable seed percentage and electrical conductivity. For conducting all experiments, ISTA (2009) rules were applied for the last year (2011-2012) that the agricultural yield had been under the cultivation of sunflowers and following the harvest, the land was irrigated at the beginning of autumn. It was ploughed, then fertilized and harrowed. Experimental units were established at 2×6 m and they were placed 2 m away from neighbouring experimental units. The distance between two blocks was 1 m. Ten rows at a 20 cm distance were determined from each figure in each plot. Seeds were placed at a distance of 1/5-2 cm from each other and at depth of 3 cm in October 2011, with a density of 400 seeds per square metre which were planted by seed drill machine. After cultivation, once the land was irrigated at autumn for sprouting, growing and placing plants in the soil. Following on, in spring, the land was irrigated three times to protect against broad leaf weeds. Finally, at the tillering stage, 1.5 l of 2, 4-D herbicides were applied to each hectare. Seed harvesting was conducted in 10 steps to determine each phonological growth of Zadoks. In order not to impact margins, two lateral rows as much as 50 cm from the beginning and end of rows were deleted from each tentative unit harvested from 1 m^2. For take-out the seeds at each harvest time, we used the hand and in the next process we used thresher. Following on, seed sample assessment was conducted using different experiments for determining and grading their quality and desirability.

RESULTS AND DISCUSSION

As demonstrated in Table 1, variance analysis of the study's traits revealed that the impact of cultivar on thousand-seed weight, seed vigour index, mean germination time, viable seed percentage and electrical conductivity was significant. The effect of harvesting time on all traits except seedling dry weight and germination rate was significant. Additionally, the effect of cultivar on thousand-seed weight and electrical conductivity was significant at harvesting time.

Seed vigour index: The comparison of means indicated that the lowest amount of seed vigour among cultivars was 0.0089 and the highest amount of thousand-seed weight was reported as 0.0252. Accordingly, the greatest mean was associated with cultivar ADC-20 while the lowest seed vigour index was allotted to the Bahman cultivar (Fig. 1). The mean comparisons revealed that the lowest mean germination time among cultivars was equal to 9.9462 and the highest was found to be 11.5537. Taking this into account, the greatest mean was assigned to the ADC-1 cultivar and the lowest mean germination time was assigned to the Yusef cultivar (Fig. 2). There was a significant correlation between seed vigour and seedling establishment which is the first fundamental stage and plant development necessity. Traits such as germination percentage, germination rate, seedling length, seedling dry weight and vigour are considered as evaluation indexes of seed vigour at the earlier stages of development.

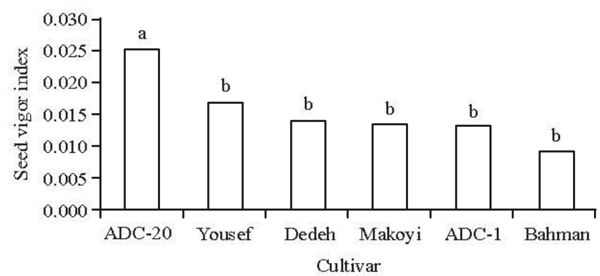

Fig. 1: Seed vigor index in the studied barley cultivars

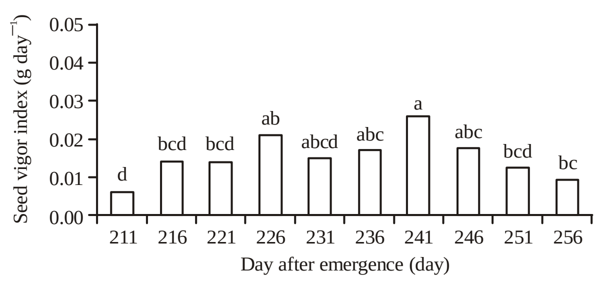

Fig. 2: Seed vigor index at different harvesting times for studied barley

Table 1: Variance analysis of traits studied

S.V	df	1000-grain weight	Seedling dry weight	Seed vigor index	Mean germination time	Germination rate	Viable seed percent	Electrical conductivity
Repeat	3	0.823	4.162	0.0018**	3.94	0.349	21.12	70.21
Cultivar©	5	1536.00**	4.020	0.0012**	10.73*	0.530	291.16**	988.58**
Harvesting time	9	2808.90**	3.930	0.0007*	56.79**	0.366	605.61**	34743.30**
C×T	45	25.80**	3.720	0.0003	5.57	0.348	26.11	547.45**
Error	176	1.70	3.760	0.0003	4.29	0.360	25.02	32.32
C.V		0.24	3.700	0.1500	0.39	1.500	0.51	0.11

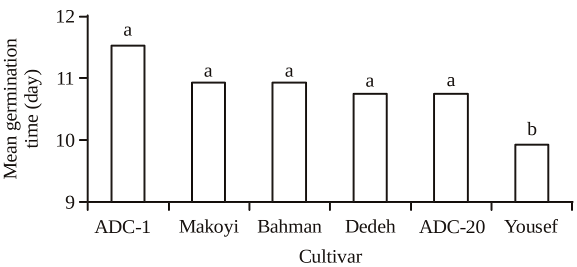

Fig. 3: Mean germination time in the studied barley cultivars

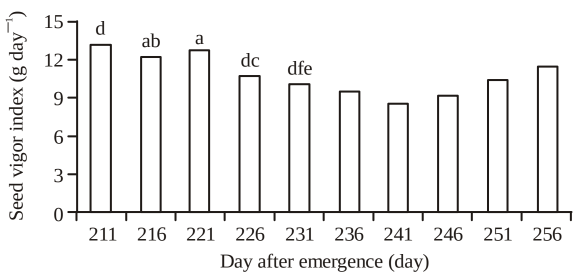

Fig. 4: Mean germination time at different harvesting times for studied barley

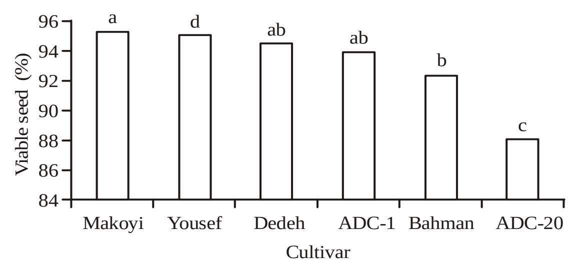

Fig. 5: Viable seed percentage in the studied barley cultivars

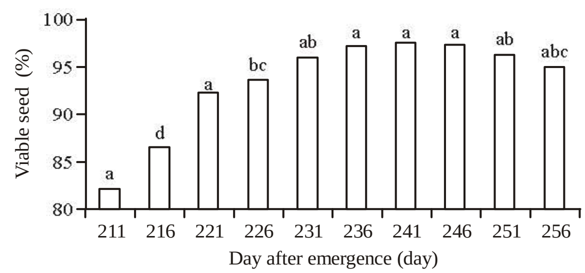

Fig. 6: Viable seed percentage index at different harvesting times for studied barley

Mean germination time: Based on the mean variations in the germination time of 6 barley cultivars at different stages of development and maturation, it was found that germination time mean in all cultivars was highest at the seventh harvest and increased again afterwards (Fig. 3). Regarding the comparison of different harvesting time means, it was found that the highest germination time mean occurred at first harvest, 211 days after emergence while the lowest germination time mean (8.6355) came about at the seventh harvest, 241 days after emergence (Fig. 4).

Viable seed percentage: The comparison of means demonstrated that the lowest amount of viable seed percentage was 88.184 and the highest amount was 95.300. As such, the greatest mean belonged to the Makoee cultivar and the lowest to the ADC-20 cultivar (Fig. 5). According to the different means of harvesting time, it was observed that the largest viable seed percentage (97.500) belonged to the first harvest at 241 days after picking while the least viable seed percentage occurred at the first harvest, 211 days after harvesting. With respect to the viable seed percentage variations of six barley cultivars at diverse stages of growth and maturation, it was discovered that the viable seed percentage of all cultivars was at their maximum at the eighth harvest, before dropping again. The low amounts of viable seed percentage at the initial stages of harvesting can be attributed to the seeds, lack of development and maturation and a secondary decrease following the delay may be the result of the onset of ageing biochemical processes after physiological maturation (Bewley and Black, 1985; Powell, 1988) (Fig. 6).

Thousand-seed weight: According to Table 2, all cultivars had a low thousand-seed weight at the early stages of harvesting and had the largest thousand-seed weight in the seventh and eighth harvests (241-246 days after emergence). Ghassemi-Golezani *et al.* (1996) reported that the maximum seed weight, germination rate and seedling dry weight extracted from wheat seeds occurred when these seeds were at the physiological maturation stage or when they were harvested just after this stage. As demonstrated in Table 3, all cultivars had low electrical conductivity at the earlier harvesting stages which was contributed to tissue immaturity. In the subsequent stages, however, electrical conductivity gradually reduced, owing to membrane maturation and decreased electrical conductivity leakage. On the whole, all studied cultivars had the least electrical conductivity in the seventh and eighth harvest (241-246 days after emergence). Mir-Mahmoodi (2000) has also suggested that the least seeped materials from seeds and the highest seed vigour in all barley cultivars under investigation have been attained at about physiological maturation. On the other hand, it has also been reported that degree of emergence can establish a reasonable relationship with performance only when more than 70% of seeds within a mass showed low electrical conductivity (Anderson and Beaker, 1983).

Electrical conductivity: The electrical conductivity of wheat seeds material leaking in early harvests was high, due to premature seeds and a failure to develop the necessary structures and tissue membranes. With grain growth, seed formation and the stabilization of membrane structure, the electrical conductivity of seed leakage showed a rapid decline to 55 days after flowering which the minimum amount of EC

Table 2: Slicing interaction of cultivar and harvesting time for 1000-grain weight

	Cultivar 1000-grain weight					
Harvesting time (day)	Makoyi	Dedeh	ADC-1	Bahman	Yousef	ADC-20
211	5.90^{f}	13.50^{f}	9.90^{g}	4.70^{g}	10.90^{f}	3.20^{f}
216	14.55^{e}	23.85^{e}	15.50^{f}	13.00^{f}	11.10^{f}	8.20^{e}
221	20.10^{d}	33.90^{d}	20.30^{e}	20.10^{e}	24.70^{e}	11.70^{d}
226	27.60^{c}	36.70^{c}	26.20^{d}	23.50^{d}	30.20^{d}	18.25^{c}
231	31.10^{b}	42.00^{b}	28.30^{c}	26.00^{c}	37.70^{a}	24.00^{b}
236	38.90^{a}	43.50^{b}	30.40^{b}	26.50^{c}	39.00^{c}	29.10^{a}
241	38.10^{a}	43.70^{b}	33.00^{a}	32.00^{c}	41.60^{b}	28.50^{a}
246	37.95^{a}	49.20^{a}	32.75^{a}	35.50^{a}	45.90^{a}	29.10^{a}
251	37.80^{a}	48.90^{a}	32.60^{a}	35.50^{a}	45.20^{a}	28.45^{a}
256	38.38^{a}	49.00^{a}	32.90^{a}	35.40^{a}	45.60^{a}	29.00^{a}
LSD (0.05%)	1.89	1.94	1.65	1.56	2.24	1.89

Table 3: Slicing interaction of cultivar and harvesting time for electrical conductivity

	Cultivar					
Harvesting time (day)	Makoyi	Dedeh	ADC-1	Bahman	Yousef	ADC-20
211	161.94^{a}	125.67^{a}	101.91^{a}	165.54^{a}	191.41^{a}	130.73^{a}
216	84.31^{b}	66.59^{b}	79.33^{b}	85.03^{b}	79.48^{b}	89.55^{b}
221	58.69^{c}	39.59^{c}	50.12^{c}	55.82^{c}	60.41^{c}	49.12^{cd}
226	36.61^{d}	38.40^{c}	34.69^{de}	48.32^{c}	40.89^{d}	51.76^{c}
231	27.63^{def}	29.08^{c}	30.19^{efg}	36.04^{d}	32.05^{e}	35.46^{fg}
236	19.51^{f}	28.02^{d}	31.09^{ef}	28.12^{de}	32.42^{e}	30.05^{g}
241	20.62^{f}	24.93^{de}	23.96^{g}	25.60^{de}	26.44^{f}	34.49^{fg}
246	25.40^{ef}	18.76^{f}	26.89^{fg}	20.40^{e}	20.41^{g}	40.31^{ef}
251	29.51^{def}	20.82^{ef}	36.02^{de}	23.77^{e}	21.97^{g}	43.43^{de}
256	34.93^{de}	23.16^{e}	39.88^{d}	28.51^{de}	26.31^{g}	42.91^{de}
LSD (0.05%)	10.58	4.27	6.39	10.85	4.13	6.53

allocated. Delay in harvesting, aging processes and damage to membranes increased minerals and amino acids seeping out of the seed and gradually increased the electrical conductivity of the material leaking from seeds (Davoodi *et al.*, 2013).

CONCLUSION

The results of this study suggest that the more substance leakage from the seeds occur, the less their life vigour and strength and accordingly, germination rate and seedling dry weights resulting from these seeds will be diminished. Given such characteristics as electrical conductivity, seedling dry weight, viable seed percentage and germination rate, seed's vigour was low at the initial stages, before gradually starting to augment with enhanced weight, seed filling and their critical structural maturation. The response of cultivar's electrical conductivity and thousand-seed weight to harvesting times was not the same: In other words, electrical conductivity and thousand-seed weight variations among harvested seeds did not follow the same trend across different stages.

REFERENCES

Al-Karaki, G., A. Al-Ajmi and Y. Othman, 2007. Seed germination and early root growth of three barley cultivars as affected by temperature and water stress. Am. Eurasian J. Agric. Environ. Sci., 2: 112-117.

Anderson, J.D. and A. Beaker, 1983. Deterioration of seeds during ageing. Phytophatology, 73: 321-325.

Bewley, J.D. and M. Black, 1985. Seeds: Physiology of Development and Germination. Plenum Press, New York, ISBN-13: 9780306447471, pp: 89-100.

Briggle, L.V. and B.C. Cutis, 1987. Wheat World Wide. In: Wheat and Wheat Improvement, Heyne, E.G. (Ed.). American Society of Agronomy, Madison, WI., USA., pp: 1-31.

Cornish, G.B., D.J. Skylas, S. Siriamornpun, F. Bekes, O.R. Larroque, C.W. Wrigley and M. Wootton, 2001. Grain proteins as markers of genetic traits in wheat. Crop Pasture Sci., 52: 1161-1171.

Davoodi, S., T. Mir-Mahmoodi and N. Khaliliaqdam, 2013. [Estimation of the optimum time of seed harvesting in several cultivars of wheat]. J. Seed Technol., 4: 34-42, (In Persian).

Fathi, G., 2001. [Growth and Nutrition Crops]. Jahad Daneshgahi Mashhad, Iran, Pages: 367, (In Persian).

Ghassemi-Golezani, K., K.S.N. Zadeh, F.R. Khoei and M. Moghadam, 1996. The effects of wheat seed development and maturation under irrigated and rain-fed condition. J. Agric. Sci., 6: 99-117.

ISTA., 2009. International rules for seed testing. International Seed Testing Association, Bassersdorf, Switzerland.

Kouchaki, G.H., 2004. [Farming in Dry Areas]. Jahad Daneshgahi Publication, Mashhad, Iran, Pages: 202, (In Persian).

Maleki, Y.A., F.N. Moayed, K.N. Mahmoodi, S.M. Azimzadeh and E. Roohi *et al.*, 2009. Abidar, a new dryland barley cultivar for moderate cold areas of Iran. Seed Plant Improve. J., 1: 227-230.

Mir-Mahmoodi, T., 2000. Quality variations of six wheat cultivars on a mother plant at different stages of seed maturation. J. New Agric. Sci., 1: 44-53.

Mohamadi, G.N., A. Siadat and A. Kashani, 2008. [Farming]. Shahid Chamran University Press, Ahvaz, Iran, (In Persian).

Perry, D.A., 1981. Handbook of Vigour Test Methods. International Seed Testing Association, Zurich, Switzerland, Pages: 72.

Poorsaleh, M., 1994. [Cereal (Wheat, Barley, Rice, Corn)]. Saffar Publication, Iran, Pages: 144, (In Persian).

Powell, A., 1988. Seed vigour and field establishment. Adv. Res. Technol. Seeds, 11: 29-61.