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# Impact of seed size on seeds viability, vigor and storability of *Hordeum vulgare* (L.)

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**ABSTRACT**

Seed size may influence seed germination, and seedling vigor. Few investigations are available about the effect of seed size on barley seedling vigor in Jordan. The present study was designed to investigate the impact of seed size on germination percentage, seedling dry weight, seedling vigor index, and germination percentage after accelerated aging in barley. Three seed sizes i.e. large, medium, and small (having diameter of > 2.75 millimeter, 2.5 - 2.75 millimeter, and < 2.5 millimeter, respectively) were tested in the experiment. Seed quality for different seed size categories was evaluated in the laboratory by measuring seed germination, germination after accelerated aging, as well seedling dry weight and vigor index. Results showed significant differences for large seeds in germination percentages, seedling dry weight and vigor index. It may be concluded that large seed size of barley showed best quality.

**Key words:** Barley, Germination, Vigor.

## INTRODUCTION

Seed is considered a basic input for agricultural development since it ensures grain production (Seboka and Deressa, 2000) and forage production Massimi *et al*. (2016). Agronomists should study different variables to improve seed quality. One of these important seed variables is seed size. It has been reported that selecting seed size improved wheat yield grown under salinity and water stress, which had higher yields when grown under severe stressful environmental conditions Mian *et al*. (1994). Terminal drought and high temperature stresses reduced seed size more than drought stress alone resulting in the production of shriveled seeds Copeland *et al*. (1995).The average seed mass decreased when the severity of drought stress during or before seed filling increased, which interrupted seed development and produced light seeds Copeland *et al*. (1995). Many researchers have reported a direct positive effect for seed size on standard germination percentage under optimum conditions. Germination percentage was higher in high test weight genotypes (87.34 %) than in low test weight genotypes (80.21 %) of triticale (Akjun and Al-Tindal, 2010). Mian *et al*. (1994) found that large wheat seeds produced larger seedling dry weight. The relationship between seed sizing and germination after aging has been studied for several species. The maximum germination percentages for corn seeds aged at 12-14°C for 8 months were higher for large and medium seeds than small seeds George *et al*. (2003). This was accounted for greater food reserves of large seeds. Aging causes a great reduction in glucose utilization as expressed by a reduction in protein content and polysaccharides synthesis.

The objectives of this study were to evaluate the impact of seed size on seed quality parameters and to provide farmers with recommendations regarding whether to categorize barley crop seeds or not.

## MATERIALS AND METHODS

Seed lots from common barley cultivars in Jordan namely "Rum" and "ACSAD176", were used in this study. Seed lots were: lot (A), from "Rum" cultivar, lot (B), from small shriveled seeds of "Rum" cultivar, lot (C) from "Rum" cultivar seeds, and lot (D) from seeds of "ACSAD176" cultivar. Seeds were cleaned and stored at 5°C until used in the experiments.

Seeds of each lot were separated into three seed size categories (large, medium, and small) by sieving through oblong perforation hand screens. Large seeds are those retained on 2.75 mm oblong screen. Medium seeds are those seeds that passed 2.75 mm oblong screen and were retained on 2.5 mm oblong screen. Small seeds are those seeds that passed 2.5 mm oblong screen.

Standard germination test was conducted for seeds as described in Association of Official Seed Analysts (AOSA 1991). Four replicates of 50 seeds were placed between folded germination papers, wet prechilled at 5°C for 5 days, then incubated at 20°C for 9 days. At the end of the germination test, normal seedlings, abnormal seedlings, and dead seeds were evaluated as described by (AOSA 1991).

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Normal seedlings were counted daily to calculate germination percentage. Normal seedlings at the end of the test were endosperm-excised, oven dried at 70°C for 48 hours to calculate seedling dry weight.

Accelerated aging test was conducted as described in the Association of Official Seed Analysts (AOSA 1991). Four replicates of 30 seeds were aged at 45°C and 100 percent relative humidity for 48 hours. After aging, the seeds were exposed to wet prechilling at 5°C for 5 days and then incubated at 20°C for 14 days to calculate seed germination percentage.

The experimental design in the lab was split in completely randomized design with four replications. An analysis of variance was made for the measured parameters using SAS program. Means were separated according to the Least Significant Difference (LSD) at a probability level of 0.05.

## RESULTS AND DISCUSSION

Table (1) showed that large and medium seed-size classes had significantly higher standard germination percentages than small size class. Large size class was significantly superior to medium and small seed-size classes for parameters of seedling dry weight (SDW) and seedling vigor index (SVI). Small size class had the lowest values for both parameters. Large size class was significantly superior to medium and small seed-size classes in the germination after accelerated aging test. Small size class had the lowest germination after accelerated aging test. Tables (2 to 5) showed the analysis of variance (ANOVA) for the effect of seed size on germination percentage, seedling dry weight, seedling vigor index, and germination after aging respectively of four seed lots.

There were differences in seed size distribution among seed lots obtained from different locations in Jordan. These results indicated that the seed size of barley is highly variable in semiarid conditions of Jordan where rainfall amounts and distribution are highly variable among locations. Terminal drought and high temperature stresses reduced seed size more than drought stress alone resulting in the production of smaller or even shriveled seeds. The average seed mass decreased when the severity of drought stress during or before seed filling increased, which interrupted seed development and produced light and shriveled seeds (Copeland *et al*. 1995). These differences among seed lots emphasized the importance of seed sizing to maintain uniformity in seed size and weight of planted barley.

With the increase in seed size, there was an increase in seed weight, germination percentage, and seed vigor as estimated by seedling dry weight, seedling vigor index, germination percentage after accelerated aging test (Table 1). This supports the conclusion by Bhattacharjee *et al*. (2000) that reported a direct relationship between seed size of *Corchorus olitorius* and seedling dry weight. This might be related to higher food reserves, cell number per seed, cell volume, respiratory rate, and energy production from large seeded seedlings. Other investigators have found that seed size had a significant effect on seedling dry weight and vigor of legumes. Renugadevi *et al*. (2009) in cluster bean

**Table 1:** Overall mean for the impact of seed size on standard germination percentage, seedling dry weight, seedling vigor index, and germination percentage after accelerated aging test.

| Seed-Size Classes | Germination Percent | Seedling Dry Weight(mg seedling$^{-1}$) | Seedling Vigor Index | Accelerated Aging Germination Percent |
|---|---|---|---|---|
| Large | 99 * | 22 * | 2220 * | 54 * |
| Medium | 99 * | 19 ** | 1828 ** | 51 ** |
| Small | 96 ** | 15 *** | 1423 *** | 48 *** |
| LSD | Means in columns not sharing same number of asterisks are significant at the 5 Percent (%) LSD probability level. | | | |

**Table 2:** Analysis of variance (ANOVA) for the effect of seed size on germination percentage of four seed lots.

| Source | d.f | Mean Squares | F Value | Probability > F |
|---|---|---|---|---|
| Seed Lots (S L) | 3 | 24.3 | 2.07 | 0.1314 |
| Replication (R) | 12 | 8.11 | 0.69 | 0.7462 |
| Size (S) | 2 | 41.33 | 3.51 | 0.0460 * |
| S L × S | 6 | 12 | 1.02 | 0.4368 |
| Error | 24 | 11.78 | *Significant at P 0.05 | |
| Total | 47 | | | |

**Table 3:** Analysis of variance (ANOVA) for the effect of seed size on seedling dry weight (mg) of four seed lots

| Source | d.f | Mean Squares | F Value | Probability > F |
|---|---|---|---|---|
| Seed Lots (S L) | 3 | 17.40 | 2.99 | 0.0510 |
| Replication (R) | 12 | 4.53 | 0.78 | 0.6656 |
| Size (S) | 2 | 235.80 | 40.59 | < 0.0001 * |
| S L × S | 6 | 12.35 | 2.13 | 0.0875 |
| Error | 24 | 5.81 | * Significant at P 0.05 | |
| Total | 47 | | | |

**Table 4:** Analysis of variance (ANOVA) for the effect of seed size on seedling vigor index of four seed lots

| Source | d.f | Mean Squares | F Value | Probability > F |
|---|---|---|---|---|
| Seed Lots (S L) | 3 | 217600 | 3.43 | 0.0330 * |
| Replication (R) | 12 | 46177.8 | 0.73 | 0.7133 |
| Size (S) | 2 | 2544233 | 40.12 | < 0.0001 * |
| S L × S | 6 | 117300 | 1.85 | 0.1316 |
| Error | 24 | 63411 | * Significant at P 0.05 | |
| Total | 47 | | | |

**Table 5:** Analysis of variance (ANOVA) for the effect of seed size on germination percentage after accelerated aging test of four seed lots

| Source | d.f | Mean Squares | F Value | Probability > F |
|---|---|---|---|---|
| Seed Lots (S L) | 3 | 316.24 | 19.03 | < 0.0001 * |
| Replication (R) | 12 | 12.10 | 0.73 | 0.7133 |
| Size (S) | 2 | 146.10 | 8.79 | 0.0014 * |
| S L × S | 6 | 29.60 | 1.78 | 0.1457 |
| Error | 24 | 16.62 | * Significant at P 0.05 | |
| Total | 47 | | | |

(*Cyamopsis tetragonoloba* (L.) Taub.) and Anuradha *et al*. (2009) in chick pea (*Cicer arietinum* L.) also recorded association between seedling vigor and seed size. Srimathi *et al*. (2003) stressed that the optimization of sieve size based on the recovery of quality seeds is warranted for better economic quality of the seed with good quality. Hence planting larger seed may improve the chances of successful seedling establishment when conditions are less than ideal.

## CONCLUSION

These results indicated that the seed size of barley is highly variable in semiarid conditions of Jordan where rainfall or irrigation amounts and distribution are highly variable. These differences among seed lots emphasized the importance of seed sizing to maintain uniformity in seed size and weight of planted barley. Seed sizing improved the uniformity of seed weight among different seed lots, large seeds had significantly higher seed quality when estimated by germination percentage, seedling dry weight, seedling vigor index, and accelerated aging test. As a final conclusion, results reported in this study suggest that seed sizing had a potential impact on improving seed quality, viability, vigor and storability of barley grown under semi-arid conditions.

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