Effect of Gamma Irradiation on Seed Germination Traits of

*Bromus inermis*

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Effect of Gamma Irradiation on Seed Germination traits of *Bromus inermis*

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Keywords: Gamma rays, germination, *Bromus inermis*.

**Introduction**

Ionizing radiation technology and in particular gamma radiation is developing as a useful treatment in crop production. Gamma rays cause different physiological and morphological responses in cells and tissues that appear as an increase in germination speed, germination capacity and growth of the leaves (Amjad and Anjum 2007). Several reports on the stimulatory affects on plant growth when exposed to irradiation techniques with radioactive rays at low doses are available (Charbaji and Nabulsi 1999; Mousa 2006). Seed treatment with low doses of gamma rays resulted in a significant increase in germination traits, plant vigor and yield attributes of wheat (Melki and Marouani 2010). High doses of gamma radiation produced deleterious effects, such as poor growth (Amjad, and Anjum 2007). Seedling establishment is a critical stage in the plant life cycle that is the result of successful germination (Liu et al. 2008).

**Materials and methods**

Dry seeds of *B. inermis* with moisture content of 9.5 percent and viability of 82 percent were divided into eight groups of 4 gram samples. The first group was kept as a control while the rest were exposed to 3, 6, 15, 20, 30, 50, 100 and 150 gray gamma irradiation doses with a dose rate of 0.18Gy/s using a source of cobalt-60 at the agricultural, medical and industrial research school, nuclear science and technology research institute, Atomic Energy Organization of Iran. To find out the effect of gamma rays on germination, 50 seeds of each treatment with 3 replications were placed in sterile petriplates using the paper towel method (ISTA 1985). Petriplates were placed in a germinator at 25°C temperature in a completely randomized design. Then seedling roots and fresh shoots and dry weights were measured, germination capacity (GC), germination rate (S), mean germination time (MGT) and Vigor index (VI) evaluated using the following equations:

- **GC (%)** = (number of germinated seeds/total number of sowed seeds) * 100
- **S (seeds/day)** = \((N_1*1)+(N_2-N_1)*1/2 + (N_3-N_2)*1/3+ ... + (N_n-N_{n-1})*1/n\)
- **MGT (day)** = \(A_1D_1 + A_2D_2 + ... + A_nD_n  /  A_1 + A_2 + ... + A_n\)
  where: \(A_i\) is the number of germinated seeds in time \(D_i\), and \(n\) is the days of the experiment until the last day of germination (Cantliffe et al. 1991).
- **VI** = \((RL + SL) × GC\)

where: RL, is seedlings’ root length, SL, is seedlings’ shoot length, and GC is germination capacity, (Abdul-Baki and Anderson 1973).

The results obtained were submitted to analysis of variance through the F test and if significant, the Duncan’s test was performed \(P \leq 0.05\) with the use of the SPSS 17 software.

**Results**

Results showed that gamma ray exposure had a significant \(P \leq 0.05\) effect on germination capacity and germination rate (Table 1). There was no consistent difference \(P >0.05\) on germination capacity, germination rate, mean germination time of vigour index detected from any gray dose gray (Table 2).

**Conclusion**

There was no significant increase in the germination characteristics of seeds treated with gamma radiation, although there was a trend toward lower germination capacity and germination rate by a dose of 150 gray. Higher exposures of gamma rays may cause injury in seeds and usually shows inhibitory effects on seeds (Majeed and Muhammad)

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**Table 1. Analysis of variance for effects of gamma ray exposure on germination capacity, germination rate (seed/day), mean germination time (day) and vigor index of *B. inermis*.**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Germination capacity</th>
<th>germination speed</th>
<th>Mean germination time</th>
<th>Vigour index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>8</td>
<td>845.335*</td>
<td>21.693*</td>
<td>3.880</td>
<td>2199.532</td>
</tr>
<tr>
<td>Within groups</td>
<td>18</td>
<td>736.667</td>
<td>13.469</td>
<td>6.987</td>
<td>2837.215</td>
</tr>
</tbody>
</table>
Table 2. The effect of various doses of irradiation on germination capacity (GC), germination rate (GR), mean germination time (MGT), and vigor index (VI).

<table>
<thead>
<tr>
<th>Gamma ray doses (Gray)</th>
<th>GC (%)</th>
<th>GR (seed/day)</th>
<th>MGT (day)</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0Gy</td>
<td>81.33 ± 5.20 ab</td>
<td>7.11 ± 1.04 cd</td>
<td>6.64 ± 0.80 a</td>
<td>72.27 ± 7.69 a</td>
</tr>
<tr>
<td>3Gy</td>
<td>93.33 ± 1.76 a</td>
<td>9.32 ± 0.39 ab</td>
<td>5.68 ± 0.18 a</td>
<td>93.43 ± 10.20 a</td>
</tr>
<tr>
<td>6Gy</td>
<td>82.00 ± 3.05 ab</td>
<td>7.84 ± 0.18 bcd</td>
<td>6.00 ± 0.34 a</td>
<td>93.66 ± 4.48 a</td>
</tr>
<tr>
<td>15Gy</td>
<td>90.66 ± 2.60 a</td>
<td>8.46 ± 0.33 abcd</td>
<td>5.71 ± 0.48 a</td>
<td>74.53 ± 8.98 a</td>
</tr>
<tr>
<td>20Gy</td>
<td>90.66 ± 1.33 a</td>
<td>9.87 ± 0.11 a</td>
<td>5.21 ± 0.09 a</td>
<td>84.70 ± 7.55 a</td>
</tr>
<tr>
<td>30Gy</td>
<td>90.66 ± 4.05 a</td>
<td>8.71 ± 0.63 abc</td>
<td>5.75 ± 0.10 a</td>
<td>90.16 ± 2.75 a</td>
</tr>
<tr>
<td>50Gy</td>
<td>84.00 ± 5.03 ab</td>
<td>7.96 ± 0.45 bcd</td>
<td>6.12 ± 0.08 a</td>
<td>79.73 ± 6.21 a</td>
</tr>
<tr>
<td>100Gy</td>
<td>84.66 ± 3.71 ab</td>
<td>8.01 ± 0.37 bcd</td>
<td>5.62 ± 0.25 a</td>
<td>74.25 ± 4.06 a</td>
</tr>
<tr>
<td>150GY</td>
<td>74.66 ± 4.37 b</td>
<td>6.98 ± 0.31 d</td>
<td>6.09 ± 0.17 a</td>
<td>68.51 ± 9.43 a</td>
</tr>
</tbody>
</table>

Means followed by the same letter are not significantly different at P<0.05

2010). These results are also in line with Kim et al. (2004) and Wi et al. (2007). Low doses of ionizing radiation can stimulate growth by affecting the network of hormonal signals in plant cells (Moussa 2006), but this was not confirmed in this study. There were, however, trends that the vigor index which is a parameter affected by seedling growth was numerically higher in treatments of 3 to 30 gray compared to the control. These beneficial effects of gamma radiation in enhancing higher germination and higher seedling growth reported by Srivastava and Kumar (2011) for sunflower (Capparis spinosa L.) and Hibiscus Sabdariffa L. were not confirmed here for Bromus inermis.

References


