Effect of seed treatments on barley germination quality

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Currently, the main task of agriculture is to increase the yield of cultivated crops, including cereals, and which is one of the main sectors of the agricultural system, where more than half of Russia's land (53%) is occupied by cereals and leguminous (FAO, 2007). Barley is one of the most important cereals, which ranks fourth after wheat, rice and corn in the world (Zhou, 2010, Lapitan et al., 2009). Barley in Russia ranks second in terms of production after wheat, which accounts for 25% of the total grain production (Medvedev P.V et al., 2015). One of the trends to improve the productivity of all crops and increase productivity at present is the treatment of cereals pre-sowing, which accelerates the rate of germination and improves seedling similarity in many crops. A laboratory experiment was conducted to determine the effects of different seed treatments on spring barley seed germination and seedling growth and early growth of Mikhalkovsky variety in Russia. The experiment was carried out at the State Agrarian University of Moscow Agricultural Academy named after KA Timiryazev in 4 replicates each one includes 100 seeds during 2017 and 2018. The experiment was performed using complete random design using three treatments (Polaris, Polaris + Siliplant and control). Variance analysis results (ANOVA) showed extremely significant (p<0.05) variations between treatments in all traits.

Keywords: Barley, seed treatments, Polaris, Siliplant, germination quality.

INTRODUCTION

Cereals are one of the main sectors of the agricultural system. The broad distribution of cereals in all agricultural areas determines the large diversity of the biological characteristics of these crops and their varieties. Cereal crops are important as food which more than half of Russia's territory (53%) is occupied by cereals and leguminous plants. Barley has been one of the most important crops since ancient times and currently has one of the highest lands for industrial use (FAO, 2007), and the fourth-ranking after wheat, rice, and maize in quantity produced and cultivation area in the world (Zhou, 2010, Lapitan et al., 2009). The increased use of wheat, rice, and maize in the human diet has led to a significant reduction in barley consumption, except for the production of alcoholic beverages such as beer (Baik and Ulrich, 2008, Mohammed H. and Legesse G.2003). In recent decades barley areas have grown rapidly, and yields have continued to grow. As a result, barley ranks second in terms of production after wheat, which accounts for 25 percent of Russia's total grain production. Since 2011 barley area has increased Russia with a total area of 9 million hectares of harvest - 9.2 million hectares in the period 2013-2014, respectively. This led to an increase in the production of barley from 490,000 tons to 980,000 tons, which is twice as much (compared to 2000). The main reasons for the expansion of barley growing is an increase in the demand for barley...
brewing. In 2014, world grain production reached 2.45 billion tons, Russia - 4.3 percent, after the US, China, EU countries, and India. As for grain exports, Russia ranks seventh after the United States, France, Canada, Argentina, Thailand and Australia (Medvedev P.V et al., 2015).

According to WHO statistics, according to the United Nations Environment Program (UNEP), nearly 3 million people are suffering from "acute pesticide poisoning" and between 10 and 20,000 people die every year from developing countries. The widespread use of chemical pesticides has become necessary for the growth of high-yield varieties of crops that have been severely affected by pests and diseases. Studies indicate that the continued use of chemical pesticides has led to the accumulation of a large number of "pesticide residues" that contaminate food for a long time and affect a people (FAO. 2011 and UNEP/GEMS, 1992).

One of the most effective ways to increase the productivity of agricultural crops is at the present time pre-sowing seed treatment by plant growth and development regulators combined with microelements. Growth regulators are considered as an environmentally friendly and economically profitable way to increase the yield of cereals, which allows the fullest possible realization of the possibilities of the plant organism, increase the resistance of plants to the effects of unfavorable environmental factors.

Siliplant is the first organ silicon fertilizer containing (7.5-7.8%) of available silicon, potassium and microelements in the chelate form. The structure of the Siliplant includes elements Fe, Mg, Cu, Zn, Mn, Mo, Co, and B. (Www.nest-m.ru, Borisova T.G., 2016 and Dobрева N.I., 2015). Silicon-containing substances in the Siliplant are represented by aqueous solutions of potassium silicate and sodium.

Siliplant increases the level of endogenous phytohormones (Auxins, Cytokinins and Gibberellins), activates the development of the root system and leaf apparatus (Lozhnikova V.N. and Slastya I.V, 2010). As well as Siliplant stimulate the production of phenols (Vakulenko V.V, 2014). It is noted that under favorable weather conditions Siliplant can completely replace fungicides, due to immune stimulating action on plants.

Polaris is a fungicidal intended for seed treatment pre sowing, which has a highly effective on seed pre-sowing and soil disinfection. Polaris stimulates the development and formation of a powerful root system as well as increases resistance plant for drought and frost.

**MATERIALS AND METHODS**

The experiments were carried out in the laboratory at the Plant Production Department of the Faculty of Agronomy and Biotechnology at the State Agrarian University of Moscow Agricultural Academy named after KA Timiryazev.

The experiment was performed using complete random design using three treatments (Polaris, Polaris + Siliplant and distilled water "control"), In 4 replications each one includes 100 seeds to determine the quality of the barley seed pre-sowing. The laboratory germination experiment was performed using a spring barley (Mikhalovsky variety) by treating the seed using the Polaris with a rate of 15 ml / 100 ml of distilled water. Siliplant was used at 0.6 ml / 100 ml of water and treated with distilled water. The sand was used at a moisture 240 ml of water / kg.

Energy of germination (EG) had been determined after 4 days from the percentage of seeds germination to the whole number of tested seeds, as well as germination percentage within 7 days of the seeds treatment. In another experiment, growth strength was measured through weight and length of roots, and weight and length of shoots.

Data were analyzed by analysis of variance (ANOVA) technique using computer software IBM SPSS statistics 20 and significant treatment means were compared using least significance difference (LSD) test at 0.05 probability level according to Gomez and Gomez.

**RESULTS AND DISCUSSION**

The recorded data showed that the response of the barley to the different seed treatments was significant, with the germination data showing a clear difference between the different seed treatments (table 1). Where the treatment of seed using Polaris + Siliplant recorded the best values for germination energy of the seed where the average difference of superiority by 5.5% and 5% when used Polaris and control, respectively.

The average rate of laboratory germination during two years of study increased by 3.6 and 2.2% when treated with Polaris + Siliplant compared to only Polaris and control (treatment with water only) respectively. This increase recorded significant differences between the three seed treatments.

When barley seed was treatment with Polaris + Siliplant increased the germination force by 10.4% and 9% compared to the control and Polaris.
respectively, and this was a significant increase. The differences were significant between the three treatments on the weight of the 100 sprouts where the treatment of seed barley with Polaris + Siliplant recorded the best values for weight of the 100 sprouts.

Analysis of the data in table (2): Revealed that the positive effect on weight 100 root (g), length of sprouts and roots (cm) when use of Polaris + Siliplant. The use of seed treatments contributed to the improvement of the length sprouts from 12.55 cm by control to 15.8 cm when used Polaris + Siliplant, Which achieved better values, compared with the use of only Polaris where the increased by 1.9 cm.

Despite the positive effect of the use of Polaris along the roots, there were no significant differences compared with control in the first year. On the other hand there were significant differences between the use of Polaris + Siliplant compared to both control and Polaris alone during two years of study.

There were also significant differences between the three treatments on the weight of 100 roots, where the weight of the roots ranged between 9.15, 12.56 and 18.49 g for the three treatments control, Polaris and Polaris + Siliplant respectively.

The positive effect of seed treatments with Polaris+ Siliplant probably due to silicon, which one of contents of Siliplant, that has the ability to improve the germination process, That results are agree with Hameed et al., 2013. As well as the use of Silicon increased germination percentage, germination energy, seedling length and vigor index. Silicon has a good effect on physiological plant response (Ghajari et al., 2015). That results are agree with Borisova T.G., 2016 seed treatment with Zircon (1-2 ml / ton), Epin-Extra (200 ml / ton) and Siliplant (30-60 ml / ton) together with a disinfectant increased the germination energy by 8 - 11 % and seed germination by 5 - 7%.

Table (1) Effect of seed treatments (Polaris and Polaris+Siliplant) on germination energy (%), laboratory germination (%) and growth power (germination force % and weight 100 sprouts gr).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Germination energy (%)</th>
<th>Laboratory germination (%)</th>
<th>Growth power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>89</td>
<td>96</td>
<td>92.5</td>
</tr>
<tr>
<td>Polaris</td>
<td>92</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>Polaris+Siliplant</td>
<td>97</td>
<td>98</td>
<td>97.5</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>2.54</td>
<td>1.23</td>
<td>1.90</td>
</tr>
</tbody>
</table>

Table (2) Effect of seed treatments (Polaris and Polaris + Siliplant) on weight 100 root gr, length sprouts (cm) and length roots (cm).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Weight 100 root(gr)</th>
<th>Length sprouts(cm)</th>
<th>Length roots(cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>10.99</td>
<td>7.3</td>
<td>9.15</td>
</tr>
<tr>
<td>Polaris</td>
<td>12.61</td>
<td>12.5</td>
<td>12.56</td>
</tr>
<tr>
<td>Polaris+Siliplant</td>
<td>17.97</td>
<td>19</td>
<td>18.49</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>1.61</td>
<td>0.34</td>
<td>1.18</td>
</tr>
</tbody>
</table>
CONCLUSION
The use of bio-preparation seed treatments (Polaris and Siliplant) on spring barley had a positive effect on many germination characteristics, which led to increased germination energy, germination rate and the growth force of the seed and increase the spread of the root system, which may be reflected on productivity in the barley field.

CONFLICT OF INTEREST
The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS
All authors contributed equally in all parts of this study.

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