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TESTING LIVING CAPABILITIES OF SEEDS OF WHEAT VARIETYS FROM BANJA LUKA (COLD TEST)

ABSTRACT

Low temperatures and drought as well as other abiotic factors, have a negative effect on a quality and amount of all grains, including wheat, which could cause great problems in near future considering that grains are foundation of nutrition in a majority of world population. Low temperatures and other stressful factors cause the forming of reactive compound inside the plant, which lead to damaging plant membranes and macromolecules. Water availability and its movement is very important in the process of seed germination, for starting seed grow and cotyledon extension. These processes are largely affected by the lands chemical potential, texture and contact area of seed and land. Two year research (2014-2015) included tracking parameters of seed germination with „cold” test in four varieties of winter wheat selected in the Agricultural institute of Republic of Srpska (Kristina, Bosanka, Orion, Jelena). The seeds used, were three or four years old. The variety Jelena had the largest percent of germination, while the variety Kristina had the longest root, as well as the largest root and coleoptiles mass. The older seeds had worst results compared to the younger ones.

Keywords: wheat, variety, germination, stress, age.

INTRODUCTION

The wheat is the most important grainy plant used in human nutrition and it is the second on the ladder of overall grain production, after the corn. Achieving stable yield does not depend only on agroecological condition of an area and genetic potential of a variety, but also on multiple other characteristics where resilience to low temperatures plays a great part (Mišić et al, 1995). Wheat is an eurotype plant, which means it has a great spread area, and it is considered that, compared to other grains, it has a waste adaptability (Briggle and Curtis, 1987), because of its resistance to cold, that is its capability to withstand temperatures lower then 1-4 °C. Since the seeds represent the beginning of plant production and provide its quality, special attention is dedicated to functioning mechanism of the seeds, regular physiological, biochemical and molecular

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analysis of the seed material, to provide insight into quality and provide solid basics for improving cultivation program, and strengthening control system in the process of seed production (Milošević *et al.*, 2007). Seed quality is a complex feature determined firstly by its germination. Determining germination of seeds by standard germination method (ISTA, 2003.) is carried out in ideal conditions so the results of the test can only apply for optimal field conditions (TeKrony, 1995., Siddique i Wright, 2004.), and average germination often exceeds field growth (Hamman *et al.*, 2002.). Also, the longevity of the seeds influence the vigor (ISTA, 2009).

The goal of this research was to test low and high temperature stress tolerance in the seeds germination period and the influence of the seeds age on germination, root length, coleoptile length, root mass and coleoptiles mass of the genotypes of winter wheat widespread on our fields.

MATERIAL AND METHODS

Research was conducted in 2014 and 2015. with seed of four different varieties of winter wheat (Kristina, Bosanka, Orion, Jelena) produced in 2011. Varieties were selected at Agricultural institute of Republic of Srpska. The seeds were stored three and four years in closed PVC bags in an air – dried facility. The seeds were first sterilized in 96% alcohol and then washed several times in distilled water. Only clean and healthy seeds were used in the experiment. The combination of sand and dirt of certain humidity were put in Petri dishes, and then a hundred seeds of every variety and age were put in it. The experiment was set in four repetitions. The Petri dishes were first stored in the fridge chamber at 4 °C on a 7 days period, while the humidity of the sand and the dirt was monitored. After that, the dishes were put in the dryer at 20 °C, for four days, until the end of the experiment. During the experiment the following parameters were measured, germination – germinated seeds from every Petri dish were counted and expressed in percentages of the full seeds number. Then, ten seeds were extracted from every repetition and length of roots and cotyledons were measured (the longest root was measured). The measurements were made with elastic measure – tape, and the germ of every germinated seed was measured. The separation of roots and coleoptiles was done with tweezers and they were weighed separately. The mass of fresh roots and coleoptiles was measured with analytic scales (Adventurer). The results were processed by three-factorial analysis of variance (ANOVA) by using the SPSS 4.5 software. The relevance of the treatments average values was tested with LSD test.

RESULTS AND DISCUSSION

The seeds germination was ranged from 73.7% to 86 % depending on variety and age of the seeds (Table 1). Jelena variety compared to Orion variety

had a much higher, and compared to Bosanka variety significantly much higher percentage of seed germination.

Table 1. Germination of wheat seeds depending on variety and age

Year Variety	2014	2015	Average
Jelena	86.0	78.5	82.3
Kristina	83.3	75.8	79.5
Orion	82.6	75.0	78.8
Bosanka	80.0	73.6	76.8
Average	82.9	75.7	79.3
	A	B	AxB
0.05	3.004	1.932	3.724
0.01	4.683	3.012	5.806

By increasing the storage time the seed germination of most agricultures significantly decreased (Saxena and assoc., 1987.; Andrić, 2004.), which is in accordance with our results because the percentage of germination was statistically much higher in 2014. (82.9%) than in 2015. (75.7%). If the seeds are not planted for some reasons, its germination energy and germination decrease in time. The time until the seeds start to lose its germination and i.e. time when they still can be used for planting and production, depends on species and varieties genetic potential. Physiological aging process of the seeds begins even before sowing, and is continued during harvest, processing, storing (Milošević and assoc., 1996), as well as conservation. Big significance is added to this problem during preservation of germplasma, and appropriate technologies of seed preservation are used, where the most important factors are low temperatures and humidity, while controlling partial oxygen pressure (Ratković, 1996).

The length of the germinating root was highly depending on wheat genotype and seeds age, as well as their interaction. The average root length (Table 2) was the largest at Kristina variety (7.41 cm), and smallest at Bosanka variety (3.96 cm). The seedlings of older seeds had shorter root than seedlings of the younger ones at a level $p=0.01$ and $p=0.05$, which is in accordance with research of fodder pea seeds of different ages (Bukvić and assoc., 2007.) and red shamrock (Bukvić and assoc., 2009.).

Coleoptiles length varied between 3.76 and 4.91 cm and differed with high significance depending on variety, age of the seeds and their interaction. The Kristina variety had the longest and Bosanka the shortest coleoptiles. Surprisingly, the older seeds had longer average coleoptiles length than the younger ones.



Figure 1. Germination of Bosanka variety

Figure 2. Germination of Jelena variety

Table 2. Length of the wheat root, coleoptiles and the total length of the seedlings (cm) depending on variety and the age.

Variety \ Year	2014	2015	Average
Root length (cm)			
Jelena	7.12	6.84	6.98
Kristina	7.63	7.19	7.41
Orion	6.80	6.40	6.60
Bosanka	4.12	3.81	3.96
Average	6.42	6.06	6.24
	A	B	AxB
0.05	0.0999	0.0645	0.1238
0.01	0.1889	0.1219	0.2343
Coleoptiles length (cm)			
Jelena	3.76	3.98	3.87
Kristina	4.91	4.78	4.85
Orion	3.96	4.25	4.10
Bosanka	4.12	4.21	4.16
Average	4.19	4.30	4.25
	A	B	AxB
0.05	0.0672	0.0432	0.1044
0.01	0.1270	0.0816	0.1574
Total seedling length (cm)			
Jelena	10.88	10.82	10.85
Kristina	12.54	11.97	12.26
Orion	10.76	13.65	10.70
Bosanka	8.24	8.02	8.12
Average	10.61	10.36	10.49
	A	B	AxB
0.05	0.5832	0.3749	0.7056
0.01	1.1022	0.7085	1.3667

The total coleoptiles length significantly depended on wheat genotype, while the age of the seeds had no statistical impact. Average seedling length was longest at Kristina variety (12.26 cm) and shortest at Bosanka variety (8.12 cm). Wheat genotype had high significance in total seedlings length, while age of the seeds had no statistical impact. (table 2) Average seedling length was longest at Kristina variety (12.26 cm), and shortest at Bosanka variety (8.12 cm). Wheat genotype had high significance in the mass of seedlings root, while age of the seeds had no statistical impact. The biggest root mass was found in Kristina variety (0.93 g) while Jelena variety had the smallest root mass (0.73 g).

Table 3. Mass of the root, coleoptiles and total seedlings mass

Variety \ Year	2014	2015	Average
Root mass (g)			
Jelena	0.71	0.74	0.73
Kristina	0.97	0.89	0.93
Orion	0.82	0.86	0.84
Bosanka	0.93	0.87	0.90
Average	0.86	0.84	0.85
	A	B	AxB
0.05	0.0334	0.0215	0.0414
0.01	0.0631	0.0406	0.0783
Coleoptiles mass (g)			
Jelena	0.57	0.68	0.63
Kristina	0.95	0.85	0.90
Orion	0.72	0.80	0.76
Bosanka	0.85	0.81	0.78
Average	0.77	0.79	0.78
	A	B	AxB
0.05	0.0220	0.0142	0.0272
0.01	0.0417	0.0268	0.0517
Total seedlings mass (g)			
Jelena	1.28	1.42	1.36
Kristina	1.92	1.74	1.83
Orion	1.54	1.66	1.60
Bosanka	1.78	1.68	1.68
Average	1.63	1.63	1.63
	A	B	AxB
0.05	0.0545	0.0351	0.0675
0.01	0.1031	0.0649	0.1279

Wheat genotype had high significance on coleoptiles mass, while age of the seed had some statistical impact on root mass. Kristina variety had the biggest

and Jelena variety the smallest coleoptiles mass (0.90 g) and (0.63 g) respectively.

Wheat genotype had high significance on total seedlings mass, while the seeds age had no statistical impact (table 3). The Kristina variety had the largest total seedling mass (1.83 g) and the Jelena variety had the smallest (1.36 g)

The influence of low temperatures in the cold test did not have a negative effect on seeds living capability, which was established in previous tests (Vujaković i sar.,2008) that leads to conclusion that physiological damage of the seeds can be caused by extended and inadequate storage as well as by damage caused by drought or frost. The speed at which the seeds germinate can depend on genetic differences in seeds size, seedlings trait and chemical composition. The parameter analysis should be conducted inside one variety, and not between them, because each one can have different sprout growing rates.

CONCLUSION

Based on conducted research of genotype and age influence on winter wheat seeds and seedlings traits, we can conclude that all examined traits were under significant influence of variety, while the age influenced germination, root length, coleoptiles length and total length and mass of the root. Jelena variety had the largest germination, and Bosanka variety the smallest. Kristina variety had the longest root, the longest coleoptiles and total length of the seedlings, while the Jelena variety had the smallest values. Seeds germination, seedlings root length, as well as total seedlings length were bigger in seeds that were three years old, and seedlings coleoptiles length in four years old seeds. Kristina variety had the biggest root mass, coleoptiles mass and total seedlings mass, while Jelena variety had the smallest values. Bigger root mass was in the three year old seeds, and coleoptiles seeds mass in the ones that were four years old, while age did not have any influence in total seedlings mass.

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