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SURVEY OF SEED GERMINATION AT PEAR LANDRACES

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Abstract

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In survey of pear seed germination in the laboratory conditions were included 10 summer landraces in total; 9 as subject of survey (avche, zetvarka, petrovka, ilinka, burnusus, mustabej, bugaranka, sitnica and medenica) from which 1 is used as standard (*karakamanka*), collected during 2010 on the territory of Republic of Macedonia. Bearing in mind that sprouting is going a little harder in the laboratory, there were conducted three treatments before setting seed for germination: I-stored in refrigerator at +17^{0}C/ T for 1 week; II-stored in a freezer at -18^{0}C/ T for 24 hours and after at room temperature (+20^{0}C/ T) for a period of 12 hours; and III- stored in a refrigerator at +4^{0}C/ T for a period of 1 week. Each variety has a different number of seeds of different size, quantity of endosperm and thickness of the seed coat, but apparently induced by different temperatures affect the ability of seed germination. From the results obtained very clear and exact reflected the superiority of treatment II compared with the other two. The number of seeds in the fruit varies in wide limits of 0.1-9.0; according to the average value of this parameter examined pear landraces can be classified into three groups, namely 1st in range of 0.1-2.0 representing with 5 landraces; 2nd in range of 2.1-3.0 representing with 4 landraces and 3rd in range >3.1 representing only with one landrace. Landraces avche, burnusus, mustabej, bugaranka and sitnica have more seeds per fruit compared to karamanka in terms of average, which confirms the high statistical significant differences ($p > 0.01$, $p > 0.05$).

Key words: pear, *Pyrus communis* L., seed germination, landrace

Introduction

Cultivated at least 3000 years of Asian continent (Kikuchi, 1946) common pear (*Pyrus communis)* widespread fruit with distinctive taste, aroma and flavor. Probably originated through the complex hybridization process conducted within a long period of wild progenitors, the wild European pear, *P. korschinskyi* (synonym = *P. pyraster*) and *P. communis* var. *caucasica* (Westwood 2002). 30 years ago in the Republic of Macedonia, one of the widely cultivated fruit plants, much appreciated and always with a good price, now is almost an endangered species that gets attention last year, financial support from the government in the form of subsidies in order not to lose. The number of landraces prevalent in Macedonia is large and can be estimated approximately 20. The traditional way of farming has encountered and the efforts of researchers working on PGRFA of this culture are evident (Milutinovič, 2005). Mainly known literaure data are refered to wild pear flowering and ripening (Jovančević and Božović, 2002), on morphological properties (Šebek et al. 1997) and just few on seed germination (Jovančević and Božović, 2003). Although literature data pointed each ripe fruit contains up to 10 smooth black (or nearly black) seeds, each with a thin layer of endosperm (Gill and Pogge, 1974), the number of seeds varies depending on the landrace. The colour of the seeds as a qualitative parameter is very variable and specific landrace trait similar like their shape and size. Problem by germination researching as with all fruit species, and with the pear is evident, mainly for reasons of dormancy of the embryo, which is rarely examined seed to

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give an assessment of viability. Many researchers as well (Gill and Pogge 1974) worked on this problem with greater or lesser success, but noticeable (Alscher-Herman et al., 1981; Teng, 2002; Westwood, 2002; Yamamoto et al., 2002). Germination is epigeal and lasts epigealna different, but longer than 5-30 days at +20^{0}T/ C (Elliset al., 1985; Macdonald, 1986), while ISTA (1993) recommended tetrazolium staining.

Materials and Methods

Origin of material

The study included 10 pear landraces (*Pyrus communis* L.*)* in total; 9 as following *avche, zetvarka, petrovka, ilinka, burnusus, mustabej, bugaranka, sitnica* and *medenica* have been subjected under survey and *karamanka* as standard. According to the period of maturation all landraces are among the group of summer.

Pattern of treatments

After carefully removing the seeds from fruits, determining their number and drying them is accessed to setting them and establish the germination rate. Seed preparation for germination includes a thorough washing and 1 day of water soaking prior to setting up for germination. For each treatment were placed 10 seeds of each landrace inter filter paper at +20^{0}C/T in three replications. This means that 30 seeds were used for each landraces. Every three days were aerated and supplied with moisture. Germination period was not previously restricted in order to examine the best conditions for seed germination, but after 18 days first sprouts appeared.

Refrigerator method

Pear seeds must first be stratified, because of hard seed coat; stratification is a method of handling dormant seeds and they are subjected to a certain period of cold by storage in the freezer. There were conducted three treatments using refrigerator and freezer before setting seed for germination: I-stored in refrigerator at +17^{0}C/T for 1 week; II-stored in a freezer at -18^{0}C/T for 24 hours and after at room temperature (+20^{0}C/T) for a period of 12 hours; and III- stored in a refrigerator at +4^{0}C/T for a period of 1 week. For the second treatment must be noted that seed should be packed in a double water resistant paper bag and double plastic one in order to avoid freezing of hygroscope moisture (free water) in the seed, creating crystals in the cells and their destruction. This chilling period will alleviate dormancy in the embryo allow in germination of pear seed. After removal from the freezer seed packages were left at room temperature for 24 hours how to adapt.

Statistical analyses

The obtained data on the number of seeds per fruit (n=10), seed energy (n=10 x 4 repetition) and total seed germination (n=10 x 4 repetition) for each of the four treatments were processed by ANOVA statistical program.

Results

Seed number per fruit

The average number of seeds in landraces is 2.5 healthy seeds per fruit. Landrace karamanka has the lowest number of seeds per fruit (0.3) which coincides with the fact that has three ploidy genetic constitution. Landraces avche, burnusus, mustabej, bugaranka and sitnica have more seeds per fruit compared to karamanka in terms of average, which confirms the high statistical significant differences (p>0.01, p>0.05) (Table 1). The large number of seeds per fruit at landraces avche, burnusus, bugaranka, mustabej and sitnica points to the fact that they have less ploidity (diploid) as confirmed by the smaller fruit size compared to other landraces.

Seed energy and total germination ability

The average see energy per treatments was 48.7%; higher seed energy is found in II and III treatment (> 50.0%) compared with the I treatment. In treatment I the average seed energy was 32.7%; the highest energy > 40.0% is determined at treatment I have landraces petrovka, avche, mustabej and zetvarka that have statistically significant differences compared to other varieties (p> 0.05, p> 0.01) (Table 1). In II treatment seed energy was found with small differences at

Table 1
Average values and variability of the seed number/fruit/ landrace

Variety	x ± Sx	σ	V, %
Avche**	2.8 ± 0.23	0.5	18.2
Karamanka	0.3 ± 1.29	0.5	200
Zetvarka*	1.3 ± 0.29	0.5	40
Petrovka**	1.8 ± 0.35	0.5	28.6
Ilinka**	1.8 ± 0.37	0.5	28.6
Burnusus**	2.8 ± 0.18	0.5	18.2
Mustabej**	3.0 ± 0.35	0.8	27.2
Bugaranka**	2.8 ± 0.23	1	34.8
Sitnica**	7.5 ± 0.16	1.3	17.2
Medenica	1.0 ± 0.0	0	0
All varieties	2.51 ± 0.34		
LSD0.05	0.9		
LSD0.01	1.2		

examined landraces, except mustabej and bugaranka that compared with the other were statistically significant differences (p>0.05). In III treatment over 60.0% seed energy showed mustabej, karamanka, petrovka and avche. The lowest energy has Ilinka and burnusus that have statistically significant differences (p>0.05), while the karamanka and petrovka on level p>0.01. In all tested treatments landrace mustabej have the highest energy 56.7% (I-45%, II-62.5%, III-62.5%), while Ilinka the lowest 39.2% (I-20%, II-50%, III-47.5%) (Table 2).

The total seed germination in I treatment was 60.7%; higher germination than an average have landraces avche, petrovka and mustabej (> 70.0%), which have statistically significant differences (p>0.01). In II treatman an average germination is amounted 84.0% higher than average germination have avche, zetvarka, petrovka, mustabej, bugaranka, sitnica and medenica, which resulted in statistically significant differences (p> 0.05). The average germination at III treatment was 79.5%; compared to average higher germination ability have avche, zetvarka, petrovka, mustabej, buga-

Table 2
Average values and variability of the seed energy/treatment/landrace

Variety	I treatment			II treatment			III treatment			I+II+III
	x ± Sx	σ	V, %	x ± Sx	σ	V, %	x ± Sx	σ	V, %	x ± Sx
Avche	47.5** ± 0.11	5	10.5	55.0 ± 0.10	5.77	10.5	62.5 ± 0.15	9.57	15.3	55 ± 0.12
Karamanka	30.0 ± 0.27	8.16	27.2	55.0 ± 0.10	5.77	10.5	65.0 ± 0.15	10	15.4	50 ± 0.17
Zetvarka	37.5 ± 0.26	9.57	25.5	55.0 ± 0.10	5.77	10.5	60.0 ± 0.14	8.16	13.6	50.83 ± 0.17
petrovka	40.0 ± 0.20	8.16	20.4	55.0 ± 0.10	5.77	10.5	65.0 ± 0.09	5.77	8.9	53.33 ± 0.13
Ilinka	20.0 ± 0.41	8.16	40.8	50.0 ± 0.16	8.16	16.3	47.5** ± 0.11	5	10.5	39.17 ± 0.23
Burnusus	30.0 ± 0.27	8.16	27.2	52.5* ± 0.10	5	9.5	45.0** ± 0.13	5.77	12.8	42.5 ± 0.17
Mustabej	45.0*± 0.13	5.77	12.8	62.5± 0.15	9.57	15.3	62.5± 0.08	5	8	56.67 ± 0.12
Bugaranka	22.5 ± 0.56	12.58	55.9	67.5 ± 0.19	12.58	18.6	60.0 ± 0.14	8.16	13.6	53.67 ± 0.30
Sitnica	27.5 ± 0.46	12.58	45.8	57.5 ± 0.17	9.57	16.7	50.0 ± 0.16	8.16	16.3	45 ± 0.26
Medenica	27.5* ± 0.18	5	18.2	50.0 ± 0.16	8.16	16.3	57.5 ± 0.17	9.57	16.7	45 ± 0.17
All avrieties	32.75 ± 0.28			57 ± 0.13			57.5 ± 0.13			
LSD0.05	12.3			12.4			11.8			
LSD0.01	17.1			17.2			16.4			

Table 3
Average values and variability of the total seed germination rate/treatment/landrace

Variety	I treatment			II treatment			III treatment			I+II+III
	x ± Sx	σ	V, %	x ± Sx	σ	V, %	x ± Sx	σ	V, %	x ± Sx
Avche	72.5* ± 0.07	5	6.9	90.0* ± 0.09	8.16	9.07	80.0 ± 0.10	8.16	10.21	80.83 ± 0.09
Karamanka	60.0 ± 0.14	8.16	13.61	75.0 ± 0.17	12.91	17.21	75.0 ± 0.17	12.91	17.21	70 ± 0.16
Zetvarka	57.5 ± 0.17	9.57	16.65	85.0 ± 0.07	5.77	6.79	80.0 ± 0.18	14.14	17.68	74.17 ± 0.14
Petrovka	77.5** ± 0.12	9.57	12.35	87.5 ± 0.11	9.57	10.94	82.5 ± 0.12	9.57	11.61	82.5 ± 0.12
Ilinka	47.5* ± 0.11	5	10.53	70.0 ± 0.20	14.14	20.2	77.5 ± 0.06	5	6.45	65 ± 0.12
Burnusus	52.5 ± 0.18	9.57	18.24	80.0 ± 0.18	14.14	17.68	77.5 ± 0.06	5	6.45	70 ± 0.14
Mustabej	70.0 ± 0.12	8.16	11.66	87.5± 0.11	9.57	10.94	80.0± 0.10	8.16	10.21	79.17 ± 0.11
Bugaranka	57.5± 0.17	9.57	16.65	87.5 ± 0.06	5	5.71	85.0 ± 0.12	10	11.76	76.67 ± 0.12
Sitnica	52.5 ± 0.10	5	9.52	87.5 ± 0.11	9.57	10.94	80.0 ± 0.10	8.16	10.21	73.33 ± 0.1
Medenica	60.0** ± 0.14	8.16	13.61	90.0 ± 0.09	8.16	9.07	77.5 ± 0.22	17.08	22.04	75.83 ± 0.15
All varieties	60.75 ± 0.13			84 ± 0.12			79.5 ± 0.12			
LSD0.05	11.7			14.9			15.5			
LSD0.01	16.2			20.7			21.5			

ranka and sitnica. No statistically significant differences are found in treatment III (Table 3).

Of all the landraces in respect of all treatments the highest germination ability showed avche and petrovka (> 80.0%) and lowest Ilinka (65.0%). Total landrace germination the average of treatments was 74.7%; most of the landraces showed higher germination in II treatment (84.0%) and least in treatment I 60.7, which have statistically significant differences (Table 3).

Discussion

The literature data found for long-term stratification of 30-90 days (Ellis et al., 1985), but according to recent research intensity of respiration of the seed is more intense by keeping the seeds at low temperature from+4 to $+6^0$T/C than at 25^0T/C (Alscher-Herman, 1981). Therefore the strategy for this research was conducted short stratification at low temperature have an effect that actually confirms the obtained results.

These investigations concern the seed number per fruit (Table 1) are preliminary that give directions for further investigation of landrace ploidity, with consideration the fact that karamanka has triploidy genetic constitution (Dimitrovski, 1974; Mratinič, 2000; Blagojevič, 2002). Diploidity points to regular and higher fertility among landraces, as noted in Table 3 where karamanka in I and II treatment has the lowest seed germination compared with other landraces, which resulted in statistically significant differences at p>0.05 for avche and petrovka in I treatment and avche and medenica in treatment II.

In terms of implemented treatment of seed material and to determine the most eligible, can be concluded that II and III treatment affect positive on seed energy and total seed germination. Between these two treatments could be say that in III treatment is determined higher seed energy (57.5%) and slightly lower total germination (79.5%) compared to treatment II. This leads to the conclusion that high seed energy is recorded in II treatment (56.0%) leads to the conclusion that the low temperature (-18C) initiates rapid decomposition of polysaccharides and probably force the activity of α-amylase resulting in the highest seed energy (84.0%). Under the treatment III where energy is also high (57.5%), the total germination is somewhat lower (79.5%), that could be concluded it is also beneficial and can be used to initiate better and faster pear seed germination.

Here it should be noted that research is fairly new, as witnessed almost insignificant number of literature and data available (Layne and Quame, 1975; Mišič, 2002; Stankovič and Mišič, 1978; Milutinovič et al., 1998). But, they suggest the possibility of further exploring and introducing other treatments for stratification of seed material in pears, and perhaps in other fruit species.

These observations suggest the possibility of generative propagation of fruit crops and getting generic substrates, which is of particular importance for grafting the varieties on their own rootstock in terms of lack of other generic rootstock.

Conclusions

The large number of seeds per fruit at landraces avche, burnusus, bugaranka, mustabej and sitnica points to the fact that they have less ploidity (diploid) as confirmed by the smaller fruit size compared to other landraces. In all tested treatments landrace mustabej have the highest energy 56.7% (I-45%, II-62.5%, III-62.5%), while Ilinka the lowest 39.2% (I-20%, II-50%, III-47.5%) that have statistically significant differences (p> 0.05). Of all the landraces in respect of all treatments the highest germination ability showed avche and petrovka (> 80.0%) and lowest Ilinka (65.0%). From all conducted treatment, at the III is determined higher seed energy (57.5%) and slightly lower total germination (79.5%) and could be recommended as suitable.

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