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EFFECT OF BUCKWHEAT SEED STORAGE DURATION ON ITS QUALITY

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Abstract: The effect of buckwheat seed storage duration on major indices of the quality was analysed. Seed collected in 1996 and stored for 30 days (analysed in 1996), seed stored for one year (analysed in 1997), seed stored for two years (analysed in 1998), seed stored for three years (analysed in 1999), seed stored for four years (analysed in 2000), seed stored for five years (analysed in 2001) and seed stored for six years (analysed in 2002) were investigated.

The results of investigation have shown that seed stored up to two years had preserved its good production traits. Seed stored longer than two years have shown poor quality traits, and seed stored over three years could not be used – its production traits (germination energy and total germination) confirmed that such seed could not be used for planting. Seed stored over five years, regardless of storage conditions, had no qualitative traits, and therefore no value.

It was also observed that longer storage duration induced decrease of seed mass.

In regard to fractions, it was observed that smaller fractions lost their quality more quickly than medium fractions.

Key words: buckwheat, seed storage duration, fractions, quality.

I n t r o d u c t i o n

Buckwheat (*Fagopyrum esculentum Moench*.) is an annual herbaceous plant. It belongs to the family *Polygonaceae*, as well as *Fagopyrum emarginatum*, *Fagopyrum rotundatum* and *Fagopyrum tataricum*, but they are less important and less grown (1).

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In our conditions, occurrence of plant diseases and pests on buckwheat is rare. This plant is resistant to the mentioned occurrences although in some researches plant louse and viruses were registered (2). Previous investigations indicated the occurrence of leaf disease caused by fungus *Ramularia* and root rot caused by *Rizoctonia* (3). The same source indicated the occurrence of insect larva *Elateridae.*

Buckwheat grows best on fertile soil, but it can also be produced on less fertile soils if they are adequatly improved (4), and the highest yields are produced in more humid regions (1).

For successful production of this culture, it is important that the seed is of good quality (5). The results of some researches indicated that the best quality is seed of large and medium fractions (6), and such seed should be used for planting.

Buckwheat has a long flowering period and its flower is rich in nectar, and therefore represents a good pasture for bees (7). Buckwheat fruit is triangular in shape. Shell makes up 40% of its mass. Seed is used in nutrition.

Buckwheat is also used in pharmaceutical industry because it contains heteroside rutin in fresh leaves 1.8%, in flower 0.7% and in stem 0.1%. Buckwheat fruit and seed contain no rutin (8).

The aim of this research was to prove whether and to what extent duration of seed storage affects its quality.

Material and Methods

In this investigation seed material of plant species buckwheat (*Fagopyrum esculantum Moench*.) was used. Cultivar »Bedija« produced at the Institute for Medicinal Research »Dr Josif Pančić« from Belgrade was tested. Natural seed material was collected from the harvest in 1996. It was processed on laboratory sieves to standard quality and used for further research. Seed was dried up to 10% of moisture content, packaged in paper bags and stored on wooden shelves in dry storage room without any light.

Besides additional processing of natural seed material, the realization of defined programme and objective of research was carried out using the following methods:

- laboratory analysis of the seed traits,
- statistical processing of experimental data.

Prior to laboratory analysis, seed was divided into three size fractions on sieves with round holes of different diameter dimensions:

- small sieve, size of seed 4 mm,
- medium large, size of seed 4.5 mm,
- large, size of seed 5 mm.

The investigations were carried out for each fraction and standard in ten repetitions with 100 seeds. Germination analysis was carried out in Petri dishes on filter paper and at constant temperature of 20°C. Germination energy (EK) was determined after four days and total germination (UK) after seven days. The same procedure was repeated each year during a seven-year period according to ISTA standards (9).

During the same years sanitary control and pest control was carried out too but the presence of disease inducers or pests wasn't registered either.

The obtained results were processed using usual mathematical-statistical procedure; the parameters of descriptive statistics were defined, whereas statistical significance of differences between calculated mean values was obtained using the model of variance analysis (10) of the following mathematical form

$$Y_{ijk} = \mu+\alpha_i+\beta_j+(\alpha\beta)_{ij}+\varepsilon_{ijk} \qquad (i = 1,2 \ldots 7;\ j = 1,2,3,4;\ k = 1,2, \ldots 10).$$

The evaluation of significance was carried out based on F-test and LSD-test for the threshold of risk of 5% and 1%.

Results and Discussion

The parameters of descriptive statistics (mean value, standard deviation and variation coefficient) of the investigated traits of buckwheat seed (germination energy, total germination and seed mass) with different duration of storage (from 30 days to 6 years) are presented in Table 1.

The highest degree of homogeneity of seed material in regard to all the investigated buckwheat seed traits was demonstrated by seed stored for 30 days and seed stored for one year, and lowest degree of homogeneity, i.e., the highest heterogeneity was demonstrated by seed stored for six years.

Average value of germination energy of buckwheat seed demonstrated significant differences in regard to the investigated variations in storage duration and between fractions, including standard material. With the increase of storage duration, the value of germination energy decreased significantly, so seed stored for 30 days (produced and investigated in 1996) as well as seed stored for one year (investigated in 1997) had the highest germination energy. Seed stored for one year had higher value of germination energy than seed stored for 30 days (Table 1). In each successive year of storage, especially after two years of seed storage, germination energy of buckwheat seed decreased significantly. In the last year (2002) seed almost had no germination energy. The results of investigation show that the obtained differences in average values of germination energy between all variants in storage duration were significant ($LSD_{ij}>LSD_{0.01}$), Table 2

T a b. 1. - Mean values and germination dispersion indices of buckwheat seeds

Duration of seed storage	Stat. indices	Germination energy				Total germination				100-seed weight			
		Fraction				Fraction				Fraction			
		4 mm	4.5 mm	5 mm	Standard	4 mm	4.5 mm	5 mm	Standard	4 mm	4.5 mm	5 mm	Standard
30 days	$\overline{X}$	90.3	92.3	95.0	91.08	93.2	96.6	98.1	95.4	2.0506	2.8280	3.384	2.9267
	S	1.8886	1.7029	2.1082	2.7809	2.0976	1.7127	1.3703	2.2706	0.1810	0.0874	0.0684	0.1047
	Cv (%)	2.09	1.84	2.22	3.03	2.25	1.77	1.40	2.38	8.83	3.09	2.02	3.57
1 year	$\overline{X}$	90.9	96.6	96.2	94.3	95.0	98.9	99.0	96.7	2.0122	2.6499	3.0484	2.8136
	S	1.6633	0.8433	2.7809	3.3350	1.5635	0.7379	1.2472	2.7101	0.1877	0.1262	0.6711	0.0985
	Cv (%)	1.83	0.87	2.89	3.54	1.64	0.75	1.26	2.80	9.33	4.76	22.01	3.50
2 years	$\overline{X}$	88.3	91.8	91.27	89.3	90.8	95.2	93.1	93.2	1.8220	2.6188	3.1497	2.6947
	S	3.4010	1.9322	1.5239	1.1595	3.2592	2.0976	1.4491	2.2509	0.2333	0.1124	0.0542	0.2247
	Cv (%)	3.85	2.10	1.67	1.30	3.59	2.20	1.56	2.42	12.80	4.29	1.72	8.34
3 years	$\overline{X}$	74.2	87.9	88.0	86.4	78.3	91.9	90.1	89.5	1.8580	2.5315	2.9012	2.6501
	S	6.1788	2.0790	2.0000	2.7568	6.2548	1.9120	1.6633	2.1731	0.2893	0.0854	0.0791	0.1096
	Cv (%)	8.33	2.36	2.27	3.19	7.99	2.08	1.85	2.43	15.57	3.37	2.72	4.14
4 years	$\overline{X}$	46.4	57.0	44.0	45.8	53.6	67.1	53.2	52.1	1.7604	2.4989	2.7911	2.5426
	S	5.4203	4.6904	5.7735	7.9972	9.9242	9.1706	7.0522	12.6267	0.2083	0.0605	0.0624	0.0895
	Cv (%)	11.68	8.23	13.12	17.46	18.52	13.67	13.26	24.24	11.83	2.42	2.24	3.52
5 years	$\overline{X}$	20.1	34.7	31.7	30.1	23.0	39.3	35.1	33.0	1.6320	2.3815	2.6979	2.419
	S	6.8386	4.5473	3.6225	4.2282	6.7330	3.3682	3.5103	4.3461	0.1600	0.0740	0.0786	0.0446
	Cv (%)	34.02	13.10	11.43	14.05	29.27	8.57	10.00	13.17	9.80	3.11	2.91	1.84
6 years	$\overline{X}$	2.2	6.8	2.8	2.5	3.7	8.9	4.3	3.9	1.4949	2.2183	2.5164	2.2547
	S	1.6865	1.4757	1.3166	0.9718	1.4944	1.5951	1.7029	1.1972	0.1397	0.0596	0.1326	0.1025
	Cv (%)	76.66	21.70	47.02	38.87	40.39	17.92	39.60	30.70	9.34	2.69	5.27	4.55

The analysis of buckwheat seed germination energy value indicates differences in regard to this trait between fractions. The lowest germination energy was demonstrated by seed of the smallest fraction and standard material in all years. Seed of 4.5 mm and 5 mm fraction size (medium large and large) in all variations of storage duration demonstrated the highest value of germination energy. Between these two fractions statistically significant differences in germination energy value were registered ($P<0.05$), and compared to the smallest fraction and standard differences were highly significant ($P<0.01$).

The investigated factors (storage duration and fraction) were mutually determining and related. Therefore, the interaction of these factors had highly significant influence on the level of germination energy ($F_{UZ}>F_{0.01}$), Table 2.

T a b. 2. - F-test and LSD test values of the properties analyzed

Property	Stat. test	Duration of seed storage	Fractions	Interaction
Germination energy	F	4012.509**	56.231**	7.950**
	LSD 0.05	1.5907	1.2025	3.1814
	0.01	2.0939	1.5828	4.1878
Total germination	F	2531.143**	42.211**	5.179**
	LSD 0.05	2.0075	1.5175	4.0150
	0.01	2.6425	1.9976	5.2850
100-seed weight	F	60.267**	467.136**	1.222^{NS}
	LSD 0.05	0.0806	0.0609	0.1612
	0.01	0.1061	0.0802	0.2121

** Significant at the level of 1% ^{NS} Stat. non-significant

Average total germination of buckwheat seed has dispersion similar to previous trait of germination – germination energy (Table 1). Seed stored for 30 days and seed stored for one year demonstrated the highest value of total germination (over 97%). Also, seed produced in 1996 and investigated in 1997 (stored for one year) showed better germination than seed stored for 30 days, but the established differences were not statistically significant ($P>0.05$), Table 2. With the increase of storage duration of seed, total germination decreased. After the third year (seed stored for two years), seed germination rapidly reduced. In the last experimental year (seed stored for six years), buckwheat seed had almost no germination. Differences between all variations of seed storage duration (except the first two) were statistically highly significant ($P<0.01$).

The value of total seed germination energy was mostly demonstrated in the case of fractions of 5 mm and 4.5 mm in all years. Smaller seed (4 mm), in all variants of storage duration, as well as standard seed material, had the lowest value of germination. The presented data indicate the fact that size of buckwheat seed fraction determines the increase of germination energy and germination. It is also established that smaller fraction rapidly looses its quality and the medium fraction maintains the quality for the longest period. The registered differences in value of total germination between two distinct fractions are statistically highly

significant ($P<0.01$), except between the smallest fraction and standard where determined differences weren't statistically significant ($P>0.05$). The interaction between the investigated factors also showed statistical significance ($F_{UZ}>F_{0.01}$), Table 2.

The results for realized average mass of buckwheat seed stored during different periods showed considerable variations and differences between the investigated variants of storage duration and fractions. It was established that duration of storage influences the decrease of seed mass. Seed stored for 30 days, all fractions including standard, had the greatest seed mass, whereas seed investigated in 2002 (stored for six years) had the lowest mass. The defined differences in mass of seed stored in different periods were statistically highly significant ($P<0.01$), except for the mass of seed stored for one year and two years (investigated in 1997 and 1998). Statistically highly significant were also differences observed between all fraction sizes, including standard ($P<0.01$), Table 2. The interaction showed no statistical significance, so in regard to this trait the analysed factors appear independently.

Conclusion

Based on carried out research and analysis of obtained results, the following can be concluded:

- longer storage of buckwheat seed causes loss of germination,
- only seed stored not longer than three years should be used for planting,
- seed must be separated into fractions, and only the large fraction should be used for planting,
- smaller fraction should be used for commercial purposes,
- seed stored longer than three years should be used in nutrition with previous analysis of the quality of flour.

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UTICAJ STAROSTI SEMENA HELJDE NA NJEGOV KVALITET

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R e z i m e

Analiziran je uticaj dužine čuvanja, odnosno starosti semena heljde na najvažnije parametre njegovog kvaliteta. Ispitivano je seme sakupljeno 1996. godine i to staro 30 dana (ispitivano 1996. godine), staro jednu godinu (ispitivano 1997. godine), staro dve godine (ispitivano 1998. godine), staro tri godine (ispitivano 1999. godine), staro četiri godine (ispitivano 2000. godine), staro pet godina (ispitivano 2001. godine) i staro šest godina (ispitivano 2002. godine).

Rezultati istraživanja pokazuju da je seme starosti do dve godine zadržalo dobre proizvodne osobine. Seme starije od dve godine brzo je gubilo kvalitet, te ono starije od tri godine više nije bilo za upotrebu, odnosno njegove proizvodne osobine (energija klijanja i ukupno klijanje) su toliko oslabile da ono više nije bilo za setvu. Seme staro pet i više godina bez obzira na odgovarajuće uslove čuvanja nema više nikakvih kvalitativnih osobina pa samim tim ni upotrebnu vrednost.

Primećeno je da se sa dužinom čuvanja smanjuje i masa semena.

Kada su u pitanju frakcije zapaža se da sitna frakcija najbrže gubi kvalitet, a da ga srednja najduže zadržava.

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