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Zdenka Procházková[1], Lena Bezděčková[1], Jarmila Martincová[2] and Eva Palátová[3]

Quality of beechnuts from different crop years

Abstract: Fresh and stored beechnuts collected in 1992, 1995, 1998, 1999 and 2000 were tested for viability and in 1998, 1999 and 2000 also for germination. Germination parameters such as peak value, mean weekly germination (modified mean daily germination), germination capacity, and germination value (Czabator 1962) were calculated from the germination test data and these indicators were also used for comparing beechnut quality.
The highest viability for pre-stored beechnuts occurred in 1998 (80%) and this increased by 4% when these seedlots were stored for 1.5 years. Viability of fresh beechnuts collected in 1992, 1995 and 1999 was 64, 73 and 77%, respectively. Viability of 1995-collected beechnuts decreased after 3 years storage. Germination of fresh seeds was only done for the 1998, 1999 and 2000 collections where the best germination occurred for the 1998 collection. Germination of beechnuts collected in 1992 and 1995 was significantly reduced after 3 and 6 years of storage, respectively, while beechnuts collected in 1998 and stored for 1.5 years germinated about 15% better than fresh seeds of the 1999 crop. The peak value, mean weekly germination and the time required for viable seeds to reach 80% germination showed that the 1998 crop had the highest, overall quality. Eighty percent of the viable seeds collected in 1998 germinated in 9–10 weeks while fresh beechnuts from 1999 needed nearly 13 weeks to germinate, as did beechnuts collected in 1992 and stored for 7 years. Besides the germination capacity the germination value seems to be the very good indicator for determining the quality of stored beechnuts.

Additional key words: *Fagus sylvatica*, germination, viability, storage, germination value

Addresses: [1]Research Station Uherske Hradiste, Forestry and Game Management Research Institute, 686 04 Kunovice, Czech Republic, prochazkova@vulhmuh.cz, bezdeckova@vulhmuh.cz
[2]Research Station Opočno, Forestry and Game Management Research Institute, 517 73 Opočno, Czech Republic, martincova@vulhmop.cz
[3]Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Silviculture, 613 00 Brno, Czech Republic, evapal@mendelu.cz

Introduction

In 1995, nearly 100 tons of beechnuts were collected and stored at –7°C in a State Tree Seed Centre in Tyniste nad Orlici. In 1996 and 1997, beechnut germination in nurseries was satisfactory, however, in the spring of 1998 after 3 years of storage emergence in the nurseries was very poor. On average, from 66 seedlots (8,072 Kg) which were sown only 331 seedlings per 1 Kg were produced while laboratory tetrazolium testing indicated that there were 2,800 viable seeds per kilo (Procházková et Bezděčková 1999). As we wanted to get more precise information about the quality of collected beechnuts and their suitability for long-term storage we introduced germination tests in 1998.

The goals of our investigation were to: i) compare the quality of beechnuts from different crop years and ii) find the best indicator(s) of beechnut quality and suitability for long-term storage.

Material and methods

Material

The beechnuts were collected in 1992, 1995, 1998, 1999 and 2000 from different parts of the Czech Republic. After collection and processing the beechnuts with a moisture content of 8 to 11% were stored in sealed polyethylene bags at –7°C at the Tree Seed Centre in Tyniste nad Orlicí until they were brought in insulated boxes to the Seed Testing Laboratory in Uherské Hradiste. There they were stored in a refrigerator at –4°C until used for the tests. The number of seed lots collected in different years is given in Table 1.

Viability and germination tests

The beech seed lots were tested at the beginning of storage (pre-stored beechnuts) and then after each year of storage. Tetrazolium viability tests done according to the ISTA Rules (1993, 1996, 1999) were performed each year from the fall of 1992 while germination tests were made each year since the summer of 1998.

Germination tests were done using a peat-sand substrate. Four hundred seeds of each seed lot were mixed with a peat-sand (volumes 1:1) substrate (one volume of seed to two volumes of substrate) for germination in 17×12 cm boxes at 3° to 5°C. The boxes were kept closed except when they were opened once a week to check germinants. Each week the seeds with a visible radicle were considered to have germinated. These germinated seeds were counted and removed until no germination was observed for at least next 2 weeks. Then, all remaining (ungerminated) seeds were cut and the dead (rotten), empty and 'fresh' seeds were counted. Using the tetrazolium test the 'fresh' seeds were classified as being either viable or non-viable and the viable seeds were included when calculating the percent of germinated seeds.

Quality evaluation

For all seed lots on which the germination tests were carried out, germination parameters such as peak value, mean weekly germination (modified mean daily germination), germination capacity, and germination value (Czabator 1962) were calculated from the germination test data and these indicators were also used for comparing beechnut quality. The beechnut quality was thus evaluated using the averages of the following characteristics:

- *Viability*: total number of full viable seeds in %
- *Germination capacity* (GC): total number of germinated full seeds in %
- *Peak value* (PV): the maximum quotient derived from all of the cumulative full-seed germination percent on any day divided by the number of days to reach this percent
- *Mean weekly germination* (MWG): total germination capacity (GC) divided by number of weeks in which GC was reached
- *Germination value* (GV): multiplying MWG by PV
- *PVt*: time to reach the highest peak value in weeks
- G10 (30, 50, 80): time required for viable seeds to reach 10 (30, 50, 80)% germination in weeks
- *Weeks of germination*: total length of germination test in weeks

Beechnut emergence

Starting in 1998, the emergence of beechnuts that were stored and then pre-chilled at the Tree Seed Centre in Tyniste nad Orlicí was determined. At the end of the prechilling, small samples (0.5 kg) of each seed lot were sown either in a glasshouse or a plastic greenhouse or, in late spring (May) in outdoor seedbeds. The seedling numbers were counted when first leaves were well developed (Martincová et al. 1999).

Results

Quality of fresh beechnuts

Table 1 shows that the best beechnut quality was for the 1998 collection. The highest viability for pre-stored beechnuts occurred in 1998 (80%) while the viability of fresh beechnuts collected in 1992, 1995, 1999 and 2000 was 64, 73, 77 and 76%, respectively. Germination of fresh seeds was determined only for the 1998, 1999 and 2000 collections and again the best germination occurred for the 1998 collection (80%) as compared to the 1999 and 2000 crops (63 and 65%, respectively).

The average time required for the total germination was 15 weeks for the 1998 collection while for the 1999 and 2000 crops the average germination took 18 and 20 weeks. These data show that for the latter two years the dormancy was deeper and the beechnuts were less vigorous.

The same trends are seen when comparing the time required to reach 10, 30, 50 and 80% germination of viable seeds. The time when the peak value was the highest was the same as the time required for germination of 80% of viable beechnuts (Table 1). Compared with the 1999 and 2000 collections, germination value was significantly higher for beechnuts the 1998 crop while mean weekly germination and peak value did not vary so significantly among other crop years (Table 1).

Quality of stored beechnuts

The high quality of the 1998-collected beechnuts was confirmed after 6-month storage when compared with the 1999 crop (Tables 2, 3, Fig. 1). Besides the germination capacity, especially the germination value and the length of germination differed between

these crops. Beechnuts collected in 1998 and stored for 1.5 years germinated about 15% better than fresh seeds of the 1999 crop. The peak value, mean weekly germination and the time required for viable seeds to reach 80% germination showed that the 1998 crop had the highest, overall quality. Eighty percent of viable seeds collected in 1998 germinated in 9–10 weeks while fresh beechnuts from 1999 needed nearly 13 weeks to germinate, as did beechnuts collected in 1992 and stored for 6.5 years. Also, nearly all seed lots of the 1998 crop reached the G 80 (Table 3).

The quality of a few seed lots collected in 1992 and stored for nearly 8 years was comparable to the 1995-collected beechnuts stored for 3.5 years (Tables 2, 3, 4). The low quality of the 1995 beechnuts was verified by their uneven and very low field germination compared to other crops. The emergence of the stored beechnuts from the 1995 crop mostly started more than 2 weeks after sowing and the last seedlings appeared about 2 months later. These last seedlings showed decreased vigour and the plants subsequently died. Root tip damage and lack of positive geotropism were often observed.

Table 1. Quality of fresh (pre-stored) beechnuts

	Year of collection				
	1992	1995	1998	1999	2000
Number of seed lots	155	331	40	27	36
Viability (%)	64	73	80	77	76
Germination capacity (%)	N	N	80	63	65
Weeks of germination	N	N	15	18	20
G10 (weeks)	N	N	5	8	9
G30 (weeks)	N	N	7	10	11
G50 (weeks)	N	N	8	12	13
G80 (weeks)	N	N	10	13	15
Mean weekly germination	N	N	5	4	3
Peak value	N	N	8	4	4
PVt (weeks)	N	N	9	13	15
Germination value	N	N	40	16	12

N – no germination tests
PVt – time to reach the highest peak value in weeks
G10 (30, 50, 80) – time required for viable seeds to reach 10 (30, 50, 80)% germination in weeks

Table 2. Quality of beechnuts with moisture content of 8–11% and stored at –7°C

	Number of tested seed lots								
	6	4	3	124	40	40	40	27	27
	Year of collection								
	1992			1995		1998		1999	
	Length of storage (years)								
	5.5	6.5	7.5	2.5	3.5	0	0.5	0	0.5
Viability (%)	75	63	77	68	57	80	80	77	77
Germination capacity (%)	52	52	61	39	34	80	80	63	68
Length of germination (weeks)	19	19	18	19	17	15	16	18	18
G10 (weeks)	9	7	7	9	9	5	5	8	8
G30 (weeks)	11	8	9	11	10	7	7	10	9
G50 (weeks)	12	10	11	12	11	8	8	12	11
G80 (weeks)	13	13	12	14	14	10	10	13	13
Mean weekly germination	3	3	3	2	2	5	5	4	4
Peak value	4	4	5	3	2	8	8	4	5
PVt (weeks)	13	11	11	13	12	9	9	13	13
Germination value	12	12	15	6	4	40	40	16	20

PVt – time to reach the highest peak value in weeks
G10 (30, 50, 80) – time required for viable seeds to reach 10 (30, 50, 80)% germination in weeks

Table 3. Percentage of seed lots of which 10 (30, 50, 80)% viable seeds germinated after different periods of storage

	Number of tested seed lots								
	6	4	3	124	40	40	40	27	27
	Year of collection								
	1992			1995		1998		1999	
	Length of storage (years)								
	5.5	6.5	7.5	2.5	3.5	0	0.5	0	0.5
G10 (%)	100	100	100	89	81	100	100	100	100
G30 (%)	100	100	100	68	75	100	100	100	100
G50 (%)	83	100	100	53	57	100	100	96	100
G80 (%)	33	50	33	22	17	90	97	63	81

G10 (30, 50, 80): percentage of seed lots of which 10 (30, 50, 80)% viable seeds germinated

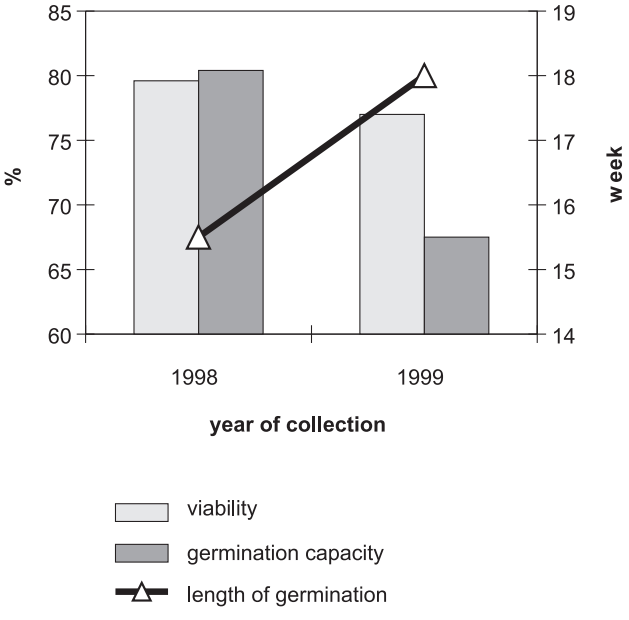

Fig. 1. Quality of the 1998 and 1999-collected beechnuts after 6 months of storage

Table 4. Changes in the quality of the same beech seed lots collected in 1992, 1995 and 1998 and stored at –7°C

	Number of tested seed lots								
	2			3			8		
	Year of collection								
	1992			1995			1998		
	Length of storage (years)								
	5.5	6.5	7.5	2.5	3.5	4.5	0	0.5	1.5
Viability (%)	76	74	73	83	68	79	80	79	83
Germination capacity (%)	54	68	56	77	71	63	84	82	78
Length of germination (weeks)	19	19	18	20	18	19	15	16	16
G10 (weeks)	9	5	9	9	8	8	6	5	6
G30 (weeks)	10	6	10	10	9	10	7	7	8
G50 (weeks)	12	8	12	12	10	12	8	8	8
G80 (weeks)	*	13	*	14	17	15	10	10	10
Mean weekly germination	3	4	3	4	4	3	6	5	5
Peak value	5	6	5	5	5	4	8	8	7
PVt (weeks)	12	9	12	14	13	13	10	10	11
Germination value	15	24	15	20	20	12	48	40	35

PVt – time to reach the highest peak value in weeks
G10 (30, 50, 80) – time required for viable seeds to reach 10 (30, 50, 80)% germination in weeks

Conclusion

Based on the presented results the beechnuts collected in 1998 have demonstrated the best quality by that time. Besides the germination capacity, the germination value seems to be a very good indicator for determining the quality of stored beechnuts.

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