CZECH MYCOL. 49 (1), 1996

Discharge of basidiospores from Fistulina hepatica fruitbodies in the natural environment

JÁN GÁPER

Technical University, Faculty of Ecology, Dept. of General Ecology,
Štúrova 4, SK-96053, Zvolen, Slovakia

Gáper J. (1996): Discharge of basidiospores from Fistulina hepatica fruitbodies in the natural environment. – Czech Mycol. 49: 41–48

Airborne basidiospores released from naturally produced basidiocarps of the beefsteak fungus Fistulina hepatica (Schaeff.): Fr. were collected by placing simple spore samplers below the centres of developing basidiocarps at two localities in Central Slovakia. This fungus liberates its basidiospores from the beginning of July to the first half of November. From 1 mm^2 of hymenophore with tubes $2.4 \times 10^1 - 5.04 \times 10^4$ basidiospores were discharged in the course of 24 hours. Basidiospore counts were the highest from orange-red and orange-red to bruising reddish brown pore surfaces. The course of spore discharge in relation to rainfall data is ambiguous.

Key words: Spore discharge, Fistulina hepatica, sporulation, airborne basidiospores.

Gáper J. (1996): Uvoľňovanie bazídiospór z plodníc trúdnika Fistulina hepatica v prirodzených podmienkach – Czech Mycol. 49: 41–48

Uvoľňovanie bazídiospór z dobre vyvinutých plodníc pečeňovca dubového Fistulina hepatica (Schaeff.): Fr. sa sledovalo v r. 1991 a 1992 na dvoch lokalitách na strednom Slovensku. Spóry vypadávali na krycie sklíčka uložené na stojane, ktoré boli umiestnené pod plodnicami v teréne. Vypadávanie spór sa hodnotilo kvalitatívne a kvantitatívne počítaním v Bürkerovej komôrke.

Spóry sa uvoľňovali od začiatku júla do polovice novembra.

Z 1 mm^2 hymenoforu sa za 24 hodín uvoľnilo $2,4 . 10^1$ až $5,04 . 10^4$ bazídiospór. Spóry sa najintenzívnejšie uvoľňovali z plodníc s oranžovočervenými až červenkastohnedými ústiami rúrok.

INTRODUCTION

The beefsteak fungus, *Fistulina hepatica* (Schaeff.): Fr., causes a brown staining and then sometimes decay of living or dead oaks (*Quercus* sp. div.) or sweet chestnut (*Castanea sativa* Mill.) and commonly forms tongue or bracket-like fruitbodies, usually near the base of standing trees, but on trunks, branches and stumps too (Černý 1982, Kotlaba 1984).

Nuss (1975) reported that fructification attained maturity after nearly two weeks and fruitbodies sporulated under favourable conditions during nearly five weeks. Decomposition and insect consumption of older basidiocarps proceeded very quickly. Analysis of basidiospore discharge in relation to natural climatic factors showed that autumn sporulation finished at average temperatures above +15 °C. Nuss (1975) concluded that beefsteak fungus basidiocarps liberate their spores from the end of August to October. As fruitbodies had been produced during this period, Nuss (1975) could not gain information on sporulation of this species during a larger period of the year. In our conditions namely, as pointed out by Kotlaba (1984), fructification of this fungus was observed from June to November. Generally, basidiocarp creation slowly increases, peaks in August and then steadily declines (Kotlaba 1984).

Up to the present day we know little or nothing about basidiospore discharge (of a statistically sufficient number) of the beefsteak fungus fruitbodies during the whole fructification period. There are even no satisfactory quantitative data available. This paper reports on our investigations of quantitative spore release of this fungus during its fructification period. The work is part of a study on the sporulation of wood-destroying fungi in both natural and urban stands.

MATERIAL AND METHODS

Simple samplers were placed below naturally produced basidiocarps. The sampler consists of three covering glass slides on a holder placed c. 2 mm below the pore surface centre of a developing basidiocarp. The spore deposition samplers were left in the field for 24 hours to have the basidiospores discharged. If spore deposit on rates were very high, it was impossible to count the spores, and therefore the covering glass slides were changed several times over a 24-hour period.

In 1991 fruitbody presence was recorded from 5 June to 29 October (Table 1), in 1992 from 9 June to 14 November (Table 2), by investigating the localities 11 times each year. Spore samples were taken 1–2 times in a month from July to November. Basidiospores were counted on a 1 mm^2 large part of the surface in a Burger chamber. Five various 1 mm^2 large areas of every covering glass slide were estimated. In case the basidiospore release reached its peak and basidiospores could not be counted one by one, spore numbers were rounded to 50.

In 1991 24-hour spore deposition patterns of *Fistulina hepatica* were determined in a c. 40-year old mixed forest stand 3 km west of Zvolen, Central Slovakia. Fruitbodies of *Fistulina hepatica* were found on dead standing oak trees and oak stumps. In 1992 release of basidiospores was observed in a c. 50-years old mixed stand 3.5 km southwest of Zvolen. Sporophores there grew on living trunks of the *Quercus dalechampii* Ten.

Rainfall data were obtained from the Meteorological Station of Sliač near Zvolen.

Table 1. Basidiospores collected from *Fistulina hepatica* fruitbodies under 1991 field conditions (No.= number of the fruitbodies).

Spore-collection day	No.	Pore surface colour	Estimated pore surface area [cm^2]	24-hour spore release per mm^2 $\bar{x}$	Sd	max	min
June 5	no fruitbodies						
June 20	no fruitbodies						
June 28	cushion-like fruitbodies without tubes						
July 9	1	white-yellowish	15	343	89.5	413	199
				176	36.1	197	112
				355	34.0	399	304
	2	white-yellowish to yellow-brownish	30	269	36.3	307	222
				229	10.0	241	214
				336	29.1	369	294
August 5	1	white-yellowish to yellow-brownish	40	2645	128.2	2761	2435
				2687	284.1	2948	2321
				2847	151.9	3002	2683
	2	white-yellowish to yellow-brownish	20	229	22.5	251	191
				229	17.6	246	210
				204	14.5	221	184
	3	orange-red to bruising reddish brown	50	870	37.2	904	813
				906	33.8	932	869
				934	46.5	988	878
August 21	1	reddish brown	60	146	21.8	162	111
				109	11.1	126	98
				135	14.2	156	122
	2	reddish brown	40	133	7.9	141	124
				160	3.3	165	152
				138	6.5	144	128
September 4	1	reddish brown	50	94	21.3	122	69
				87	9.7	98	77
				75	5.4	83	69
September 18	1	reddish brown	6	664	430.7	1405	307
				578	63.6	641	492
				459	33.8	492	414
	2	reddish brown	8	2736	249.1	3004	2431
				719	998.6	2504	239
				83	6.3	92	76
October 2	no fruitbodies						
October 13	no fruitbodies						
October 29	no fruitbodies						

Table 2. Basidiospores collected from *Fistulina hepatica* fruitbodies under 1992 field conditions (No.= number of the fruitbodies).

Spore-collection day	No.	Pore surface colour	Estimated pore surface area [cm^2]	24-hour spore release per mm^2 $\bar{x}$	Sd	max	min
June 9	no fruitbodies						
June 25	no fruitbodies						
July 8	cushion-like fruitbodies without tubes only						
July 23	1	yellow-brownish	30	123	18.8	145	95
				145	30.6	173	98
				228	25.1	261	196
August 6	1	yellow-brownish	40	4026	310.4	4422	3642
				3553	189.8	3756	3268
				3379	355.6	3722	2989
	2	yellow-brownish	90	5742	279.8	6040	5410
				4968	67.2	5030	4860
				4598	384.8	4920	4120
	3	orange-red	120	41900	3382.8	47500	38950
				39540	2229.5	42350	36850
				43616	11856.1	44680	41650
August 22	1	white-yellowish to yellow-brownish	80	691	101.2	786	544
				599	90.8	723	477
				283	37.4	324	233
	2	orange-red to bruising reddish brown	50	24660	4121.8	29450	19600
				23220	2534.9	26950	20850
				24510	2613.3	27350	21650
	3	reddish brown	130	78	17.1	108	66
				110	44.0	178	67
				103	24.3	135	68
	4	reddish brown	20	39	7.9	47	30
				35	7.8	44	24
				79	9.1	92	68
September 10	1	white-yellowish	20	184	40.5	235	131
				164	21.5	192	142
				198	11.6	216	185
	2	reddish brown	100	616	91.4	745	495
				715	18.7	743	698
				647	46.6	698	596
	3	reddish brown	10	73	4.6	78	67
				101	9.2	111	87
				115	17.2	141	98

Table 2. Continuation.

Spore-collection day	No.	Pore surface colour	Estimated pore surface area [cm^2]	24-hour spore release per mm^2 $\bar{x}$	Sd	max	min
September 27	1	white-yellowish	30	185	27.2	230	158
				120	11.8	141	111
				45	34.6	24	86
	2	white-yellowish to yellow-brownish	150	2520	457.8	3300	2090
				3338	435.9	4030	2860
				2828	111.0	3050	2630
	3	yellow-brownish	15	134	54.2	185	67
				153	54.2	211	101
				215	48.6	296	169
	4	yellow-brownish to orange-red	60	7010	623.5	7930	6240
				6113	740.8	6820	5175
				6140	563.6	6750	5500
	5	orange-red to bruising reddish brown	50	47760	3654.6	50400	42600
				38280	1644.5	40050	35850
				43260	2610.1	47400	40950
October 14	1	white-yellowish	40	176	52.9	261	128
				105	20.3	135	81
				151	27.8	186	122
	2	yellow-brownish	120	4592	931.0	5790	3290
				5597	730.4	6640	4950
				6062	151.7	6220	5870
	3	orange-red to bruising reddish brown	180	37440	1448.1	39150	35700
				41070	2991.3	46650	36750
				40290	1561.3	42500	38550
October 27	1	reddish brown	160	200	30.0	253	183
				102	27.7	127	59
				135	46.5	217	102
	2	reddish brown	190	2692	2417.2	5401	183
				3478	683.2	4500	2980
				2115	1713.9	3845	214
November 14	1	reddish brown	70	159	24.0	194	133
				98	30.6	147	67
				82	31.1	120	40

RESULTS AND DISCUSSION

The basidiocarps varied greatly in pore surface area and total number of basidiospores produced (Tables 1, 2). The beefsteak fungus pore surface was at first white-yellowish to yellow-brownish, then orange-red to bruising reddish brown and finally reddish brown. Basidiospore counts were the highest from orange-red and orange-red to bruising reddish brown pore surfaces (Table 2). However, some irregularities in spore density on glass were observed (see for instance spore deposition data from 18 September in Table 1 and from 27 October in Table 2). Similarly, Gay et al. (1959) observed some irregularities in spore density in *Trametes gibbosa*. Taggart et al. (1964) supposed that this phenomenon is caused by air currents in the spore collection apparatus used. In contrast, we agree with the opinion of Gay et al. (1959) that these spore deposition differences are real.

24 hours spore deposition data are shown in Tables 1 and 2. These data generally represent high and low periods of spore deposition. From the beginning of June to the beginning of July no fruitbodies with tubes and, of course, no spores were produced. In 1991 the highest deposition rates occurred in August with a maximum on 5th August (3002 basidiospores per mm^2) and in September with a maximum on 18th September (3004 basidiospores per mm^2). In 1992 the highest deposition rates occurred irregularly from the beginning of August to October with a maximum on 27th September (50,400 basidiospores per mm^2). The lowest was in both July and November with the lowest count on 14th November (40 basidiospores per mm^2). Generally, sporulation in 1991 was much less intensive than in 1992.

Figs. 1 and 2 illustrate the course of rainfall in 1991 and 1992. Correlations are, of course, ambiguous.

We agree with the opinion of Nuss (1975) that the fruitbody consistency of the beefsteak fungus is relatively soft and therefore its decomposition goes very fast. As pointed out by Gáper (1994), the time of basidiospore release from such sporocarps is much shorter than of those polypores with tougher fruitbodies. On the other hand, our results definitely confirm the opinions that soft fruitbodies sporulate already a few weeks after primordium creation (Nuss 1975, Soukup 1987).

ACKNOWLEDGEMENT

This work was partially supported by the grants No. 2/0230 and GE-3000 from both the Slovak Grant Agency and the Institute of Forest Ecology of the Slovak Academy of Sciences in Zvolen, Slovakia.

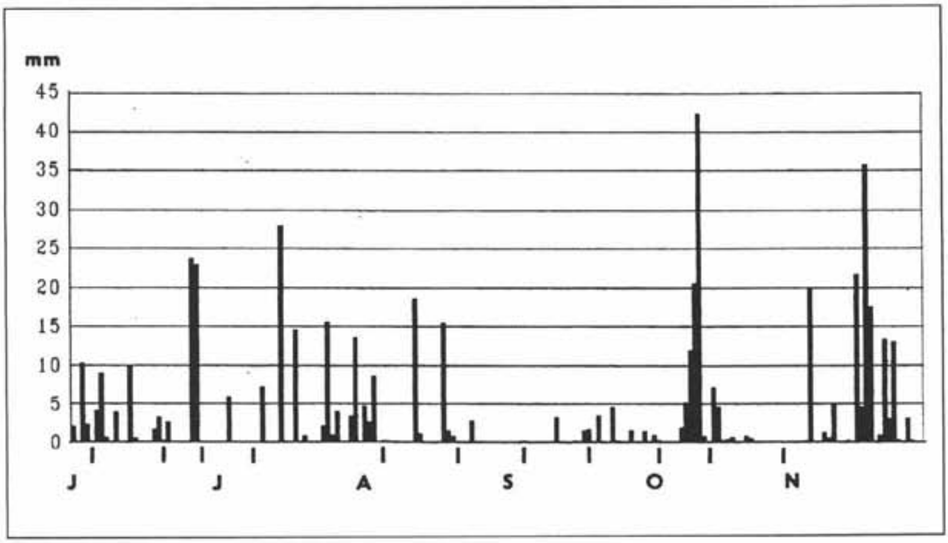

Fig. 1. Daily precipitation depths under 1991 field conditions from June 1st to November 30th with spore-collection days marked.

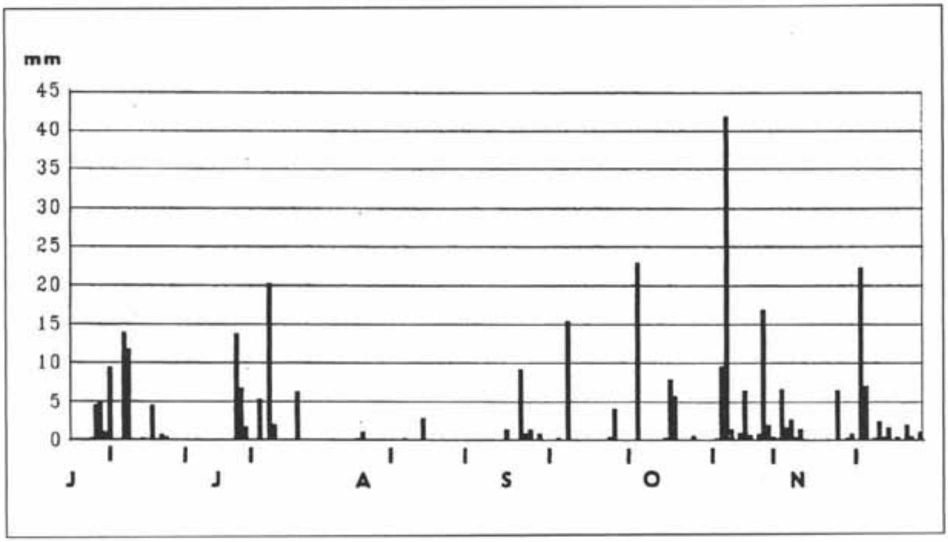

Fig. 2. Daily precipitation depths under 1992 field conditions from June 1st to November 30th with spore-collection days.

REFERENCES

ČERNÝ A. (1982): Biology of the beefsteak fungus, Fistulina hepatica (Schaeff.) ex Fr. and its significance for forest in Czechoslovakia. – Lesnictví 28: 399 – 412. (In Czech).

GÁPER J. (1994): Fructification and sporulation of Laetiporus sulphureus in the urban environment. – Czech Mycol. 47: 163 – 169.

GAY J.L., HUTCHINSON S.A., and TAGGART J. (1959): Spore discharge in the Basidiomycetes I. Periodicity of spore discharge by Trametes gibbosa Fr. – Ann. Bot. 23: 297 – 306.

KOTLABA F. (1984): Geographical distribution and ecology of the polypores (Polyporales s. l.) in Czechoslovakia. – Praha, 240 pp. (In Czech).

NUSS I. (1975): Ecology of polypores. – Biblioth. Mycol 45 : 1 – 258. (In German).

SOUKUP F. (1987): A contribution to the knowledge of sporulation of some polypores II. – Lesnictví 33: 145 – 158. (In Czech).

TAGGART J., HUTCHINSON S.A. and SWINBANK P. (1964): Spore discharge in Basidiomycetes III. Spore liberation from narrow hymenial tubes. – Ann. Bot. 28: 607 – 618.