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# Size and shape of basidiospores in the *Phellinus igniarius* group

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**Abstract.** *Phellinus igniarius* group, one of the most important wood-rotting fungi of many deciduous trees, was described as two species *(P. igniarius, P. nigricans)* more than a hundred years ago. Nowadays, in this group there are known 11 macromorphologically similar species, nine out of which occur in Estonia *(P. alni, P. cinereus, P. igniarius* s. str., *P. laevigatus, P. lundellii, P. nigricans, P. populicola, P. tremulae, P. tuberculosus).* These species, difficult to distinguish morphologically, are genetically different.

The aim of the study is to find possible differences in the size and shape of basidiospores of the species of the *Phellinus igniarius* group. There are some clear differences in the spore size of the species, but even being statistically significant, they do not enable us to identify the specimens in all cases.

**Key words**: basidiospores, *Phellinus igniarius*

## INTRODUCTION

There are still some taxonomical problems in delimiting species in the *P. igniarius* group. Originally, there were only two species in this group: *Polyporus igniarius* (synonyms: *Boletus igniarius, Fomes igniarius, Phellinus igniarius)* growing on Salix and Fraxinus trees, and *Polyporus nigricans (Fomes nigricans, Boletus nigricans)* growing on Betula (Fries, 1821). It was asserted that the same species may have different varieties depending on the host tree, for example, *Cerasus, Ribes, Prunus, Salix* or *Populus* (Purton, 1821). On drupes *Fomes igniarius* var. *minor* was known which has small and perpendicular basidiocarps (Fries, 1821). Nowadays this fungus is *P. tuberculosus,* clearly separated from the other species by its microscopical and cultural characteristics as well as *P. tremulae* and *P. populicola* (Niemelä, 1974; Niemelä, 1975; Niemelä, 1977). Sometimes these species are difficult to distinguish morphologically; nevertheless, they are different genetically (Fischer, 1987; Fischer, 1995; Fischer & Binder, 1995).

More than a hundred years ago *P. igniarius* was regarded as two species; now it comprises at least 11 species, nine of which have been found in Estonia (Parmasto, 2004). In the *P. igniarius* group, differences between the species are small, but reliable if properly measured (Niemelä, 1972). The aim of the study is to find possible differences in the size and shape of basidiospores of the species of the *P. igniarius* group.

## MATERIALS AND METHODS

The following species were studied: *P. alni* (Bondartsev) Parmasto, *P. cinereus* (Niemelä) M. Fischer, *P. igniarius* (L.: Fr.) Quél., *P. laevigatus* (Fr.: Fr.) Bourdot & Galzin, *P. lundellii* Niemelä, *P. nigricans* (Fr.: Fr.) P. Karst., *P. populicola* Niemelä, *P. tremulae* (Bondartsev) Bondartsev & Borisov in Bond., *P. tuberculosus* (Baumg.) Niemelä.

This study is based on the collections of the mycological herbarium of the Institute of Agricultural and Environmental Sciences of the Estonian University of Life Sciences (TAA(M)). Most of the specimens were collected in Estonia; several European collections were also studied. A section was made of each basidiocarp. When possible, spores were measured from spore prints, collected on black paper. Basidiocarp sections or spore prints were soaked in 3% potassium hydroxide (KOH) solution, covered with coverslip and then studied under a Nikon Labophot-2 microscope. The enlargement was 600x. Ninety-four (94) specimens from nine species were studied. Thirty (30) spores of each specimen were measured, which is a sufficient number (Parmasto & Parmasto, 1987). The total number of spores measured was 2820.

Spore variation within one individual is the character of this particular individual and it may be used toe characterize only this specimen, not that of the entire species (Raitviir, 1972; Parmasto & Parmasto, 1987). The mean values of spore length, width and Q (quotient of spore length and width) of these data were calculated in the case of every specimen measured. Statistical program SAS was used to perform the *Tukey*-test to compare species by their mean spore length, width and quotient.

## RESULTS AND DISCUSSION

It is easy to distinguish *P. nigricans* from the other species of the *P. igniarius* complex by its spore size: the mean spore size of *P. nigricans* is statistically remarkably larger than that of others, except *P. cinereus* (Table 1, Fig. 1).

*P. cinereus* differs statistically from *P. laevigatus*, *P. tremulae* and *P. tuberculosus* by its larger spore size and smaller Q value, from *P. populicola* by its larger spore size, from *P. lundellii* by its greater spore width and smaller Q value, (Table 1). The spores of *P. cinereus* are larger than the other species in this group, except *P. nigricans* (Fig. 1).

The mean spore size of *P. alni* differs statistically from *P. laevigatus* and *P. tremulae* by its larger size; from *P. lundellii* and *P. tuberculosus* by its greater width and smaller quotation, and from *P. populicola* by its greater width (Table 1). Differentiation between *P. alni* and *P. igniarius* is difficult and often not possible (Fischer, 1995), but it has been found that *P. alni* is well distinguishable from both *P. igniarius* and *P. nigricans* by its basidiocarp characters (Parmasto, 1976; Parmasto, 1988). Also, *P. alni* is well distinguishable from *P. nigricans* by its spore size (Table 1, Fig. 1). The spores of *P. igniarius* are smaller than the spores of *P. nigricans* and larger than the spores of *P. tremulae* and *P. laevigatus* (Table 1, Fig. 1). The spores of *P. populicola* are smaller than those of *P. igniarius* and *P. nigricans*, and are rather close to those of *P. lundellii* (Fig. 1; see also Niemelä, 1975). There is significant statistical difference between spore size of *P. populicola* and *P. nigricans* as well as *P. cinereus* and *P. laevigatus* (Table 1).

**Table 1.** Differences of mean spore size in *P. igniarius* complex (*Tukey*-test, $P < 0.05$, $N = 94$). A–significant difference of mean spore length of species, B–significant difference of mean spore width of species, C–significant difference of the mean spore quotient.

| | P. laevigatus | P. tremulae | P. lundellii | P. tuberculosus | P. populicola | P. igniarius | P. alni | P. cinereus | P. nigricans |
|---|---|---|---|---|---|---|---|---|---|
| P. nigricans | ABC | ABC | ABC | ABC | AB | AB | AB | | |
| P. cinereus | ABC | ABC | BC | ABC | AB | | | | |
| P. alni | ABC | ABC | BC | BC | B | | | | |
| P. igniarius | ABC | ABC | | | | | | | |
| P. populicola | ABC | | | | | | | | |
| P. tuberculosus | AB | | | | | | | | |
| P. lundellii | AB | A | | | | | | | |
| P. tremulae | AB | | | | | | | | |
| P. laevigatus | | | | | | | | | |

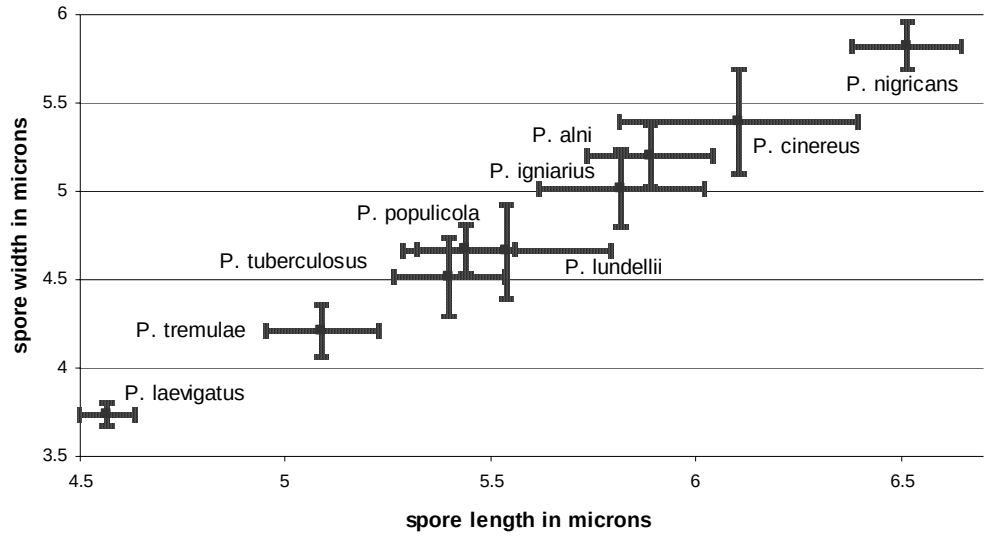


**Fig. 1.** The mean spore length, width and their standard deviations of *P. igniarius* complex.It is reliable to separate *P. tuberculosus* from *P. cinereus* and *P. nigricans* by its statistically smaller mean spore size, by smaller width and larger Q value from *P. alni* and from *P. laevigatus* by larger size (Table 1, Fig. 1).

The spores of *P. tremulae* are smaller than other species in the *P. igniarius* group, except *P. laevigatus* (Fig. 1). The mean spore size of *P. tremulae* differs statistically from *P. nigricans, P. cinereus, P. alni* and *P. igniarius* (Table 1).

The mean spore size of *P. lundellii* differs statistically from *P. tremulae* and *P. laevigatus* by its length; from *P. cinereus, P. alni* and *P. laevigatus* by its width; from *P. cinereus* and *P. alni* by its quotient and from *P. nigricans* by its size (Table 1).

In comparison with the measures of spores in *P. igniarius* group, it is revealed that the mean spore length and width of *P. laevigatus* differ statistically from the other species in the *P. igniarius* group in all cases, and by the proportions of its spore measurements in five cases out of nine (Table 1, Fig. 1). The spores of *P. laevigatus* are smaller and somewhat cylindrical.

## CONCLUSIONS

There are some clear differences in the spore size of the species in the *P. igniarius* complex. The spores of *P. nigricans* are statistically larger than the other species in this group, except *P. cinereus.* The spores of *P. laevigatus* are statistically smaller than all other species in this group. Characters used in species delimitation in the *P. igniarius* group are numerous: morphology and anatomy of basidiocarps, host, habitat and culture characteristics. The spore size seems to be a good characteristic for distinguishing the separate species, but even if the differences are statistically significant, they do not enable us to identify the specimens in all cases.

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