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Black cherry (*Prunus serotina* Ehrh.) colonization by macrofungi in the fourth season of its decline due to different control measures in the Kampinos National Park

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Abstract

The experiment conducted in the Kampinos National Park since 2015 was aimed at assessing the sprouting ability of black cherry (*Prunus serotina* Ehrh.) in response to different measures of mechanical control and mycobiota colonizing the dying trees. Basal cut-stump, cutting at ca. 1 m above the ground and girdling were performed on 4 terms, two plots and applied to 25 trees, 600 trees in total. Sprouts were removed every 8 weeks since the initial treatment for 4 consecutive growing seasons, except winter-treated trees. At the end of the fourth season of control, 515 out of 600 trees were dead (86%): 81% on Lipków and 90% on Sieraków plot. Among 18 experiment variants with sprouts removal, 17 showed more than 80% of dead trees. The lowest, 76% share, concerned summer cut-stump at the base of the tree. For winter measures, the share of dead trees was lower in all cases and ranged from 28% to 64% proving that sprouts removal contributes to the drop of sprouting strength and quicker dying of the trees. Almost 80% of trees showed sporocarps that represented 51 taxa of macrofungi in total, including 6 Ascomycota and 45 Basidiomycota. The group of six most frequently encountered fungi includes: *Hyphoderma setigerum, Bjerkandera adusta, Peniophora cinerea, Armillaria ostoyae, Nectria cinnabarina, Stereum hirsutum*. Both plots had similar share of black cherry individuals with sporocarps of macrofungi, that is, 81% and 78% for Sieraków and Lipków respectively. The share of colonized trees and the number of reported macrofungal taxa increased significantly compared to the year following the treatment. In addition, the composition of macrofungi changed with the progressing dying of trees. These results broaden the knowledge about macroscopic fungi colonising and living on black cherry within its secondary range of distribution. Moreover, one macrofungus and two microfungi new for KNP are reported.

Key words

girdling, invasive plant, macromycetes, sprouting, stump cutting, wood decay fungi

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Introduction

The invasion of black cherry (*Prunus serotina* Ehrh.) – a species of alien origin and anthropophyte established in European floras – is becoming a growing problem for nature conservation, and locally also for forest management due to its wide and still increasing spread in Europe (Vanhellemont 2009; Tokarska-Guzik et al. 2012; Bijak et al. 2014). In Poland, black cherry occurs all over the country, but mainly in its central and southwestern part. In the protected areas, including the Kampinos National Park (KNP), it is the most frequently controlled species in Poland (Tokarska-Guzik 2005; Tokarska-Guzik et al. 2012; Bomanowska et al. 2014). Many activities are undertaken, especially within the protected areas aiming to reduce its occurrence (e.g., Najberek and Solarz 2011; Otręba et al. 2014; Tittenbrun and Radliński 2015; Otręba 2016), but the thorough knowledge and analysis on their effectiveness is still in scarce. The statement by Starfinger et al. (2003) that attempts to remove black cherry undertaken without such knowledge are yet another mistake, just like the prior intentional introduction of this species seems to be still appropriate. In protected areas, the spectrum of methods that can be used is limited due to their status, which makes mechanical methods particularly favoured here. In this context, knowledge about which local species of fungi can attack and colonize wounded black cherries is extremely needed and important for both theoretical and practical reasons.

Research conducted in Belgium and Italy show that among the mechanical methods of black cherry elimination, girdling renders the best results (Van den Meersschaut and Lust 1997; Annighöfer et al. 2012), just like in the case of black locust *Robinia pseudoacacia* L. in Germany (Böcker and Dirk 2007). However, this method did not prove to be fully effective for black cherry in our experiment in KNP, as the majority of trees generated sprouts (Otręba et al. 2017). In the continuation of this long-term research, we made the observation that the share of trees without sprouts began to gradually increase in the following vegetation season depending on the variant of the experiment and that girdling contributed to the delay in time (postponement) of sprouting response of the trees (Marciszewska et al. 2018). The effectiveness of the procedures carried out in spring, expressed as the share of trees without sprouts at the end of the second growing season of the experiment, ranged from 40% to 84%, depending on the variant and was significantly higher compared for summer treatments where it ranged between 12% and 60%. Therefore, the question how long do black cherries retain the ability to regenerate in the conditions of Central Poland remains open.

Biological methods of black cherry control, also potentially promising for protected areas and relaying on the application of fungus *Chondrostereum purpureum* (Pers.) Pouzar were used in Western Europe for the elimination of undesirable deciduous species, including black cherry (e.g., Van den Meersschaut and Lust 1997; de Jong et al. 1990; de Jong 2000; Roy et al. 2010). In the above context, it is surprising that until recently, to our best knowledge, there was no targeted research on macrofungi colonizing black cherry in its secondary range of occurrence. The few published mycological and phytopathological data relating to this species as host or substrate in Poland were generally given for the genus *Padus*/*Prunus*, without distinguishing the species (e.g., Wojewoda 2003; Karasiński et al. 2014). There are known observations, including those in Rózin (the protection sub-district of the KPN), where spontaneous occurrence of wood decaying fungi was confirmed for black cherry (Namura-Ochalska and Borowa, 2015). It was not until 2018 that the publication appeared as a result of our research conducted on the assessment of methods of mechanical control of black cherry in the conditions of the KNP, in which 42 species of macrofungi found on the black cherry trees, including 26 species on trees subjected to mechanical control are reported (Marciszewska et al. 2018). Recently, the research by Baranowska et al. (2019) targeted at the identification of microfungi by molecular methods provided further data on communities of fungi occurring on the black cherry stumps. The abundance and composition of microfungi by molecular methods has also been studied by Kwaśna et al. (2008) in the roots of *Prunus serotina*, demonstrating the dominance of Ascomycota when pure-culture isolation method applied, but Basidiomycota and Ascomycota when transformation of total DNA was used.

The question of how long after the eradication treatment black cherry maintains its vegetative regenerative capacity and the issue of the macrofungi composition dynamics in relation to black cherry weakening and dying out resulting to mechanical control will be addressed in this paper.

Material and methods

The study assessing the sprouting capacity of black cherry in response to 3 various treatments of its mechanical control and mycobiota colonizing dying then trees was started in the KNP in the 2015 growing season. It is conducted in the form of an experiment in natural conditions for the next 4 vegetative seasons until 2018. Originally, a total of 600 trees from two spatially separated stands (300 trees in each stand) were selected for the experiment and treated as two distinct experimental plots. Plots are located in Sieraków and Lipków protection sub-districts, at a distance of about 3 km from each other within Laski protection district, in the KNP.

The location of study area, the characteristics of the trial trees and the research plots including soil parameters were presented in the publication summarizing the results of the first two seasons of the study (Otręba et al. 2017; Marciszewska et al. 2018). In 2018, additional pool of 50 reference trees, that is, not subjected to control (25 for each plot) was established mainly for the purpose of mycological research.

The study on sprouts generation

Three types of treatments of mechanical control of black cherry were applied: a) cut-stump at the base, b) cutting the tree stem at the height of ca. 1 m above the ground level, and c) girdling by removal of the bark, phloem and cambium at the width of ca. 20 cm around the entire circumference of the stem at the height of ca. 1 m above ground level. Details on the procedures are given in Otręba et al. (2017) and Marciszewska et al. (2018). Briefly, each of the mechanical treatments that initiated the experiment was carried out at 3 different dates in the 2015 growing season and once during the winter of 2015/2016. At each occasion, the treatment was performed on a group of 50 selected trees, 25 trees in each of the two experimental plots. A total of 450 trees were subjected to the procedure in the 2015 vegetation season and subsequent 150 trees in the winter of 2015/2016. The treatments were performed on April 8th, June 2nd, July 29th, and February 8th–10th.

The control removal and counting of generated sprouts was carried in general three times in each growing season, approximately at 8-weeks interval starting from initial treatment. At any given instance, control removal included only 450 trees; as for the winter treatment, the generated sprouts were not removed throughout the entire season. In the latter case, the sprouts were counted in the field at the end of growing season. For each tree, the presence or absence of sprouts at the subsequent control dates was recorded. These qualitative data were presented as the number of dead trees, that is, trees that did not generate shoots, for each type and time of treatment and for each plot.

Mycological research

Qualitative and quantitative assessment of sporocarps on 650 black cherry stumps and trees was carried out once between October 28 and November 12 in 2018 as the continuation of the research in 2016. Details of the methods can be found in Marciszewska et al. (2018). Briefly, the macrofugi species were determined based on sporocarps, which were not collected except for taxa hardly identifiable in the field. A list of identified species of fungi was prepared for each tree or stump, taking into accounts the type and date of the treatment and the experimental plot. Data for 600 treated and 50 reference trees are given separately.

The material collected in the field (limited number of sporocarps) was analysed using methods conventional in fungal taxonomy with implementation of light microscope (Clemençon 2009). The nomenclature was adopted predominantly after Knudsen and Vesterholt (2012) as well as the MycoBank (www.mycobank.org).

The Microsoft Office Excel package was used for generation of the database and calculations.

Results

Sprouting capability in the fourth season of control

In the fourth season of control, 515 out of 600 trees subjected to mechanical treatments were dead, equalling to 85.8% (Tab. 1). On average, the percentage share of dead trees or stumps is higher on the plot in Sieraków where 90% (i.e., 270 out of 300) of the trees/stumps were dead, while in Lipków 81% (i.e., 245 out of 300). Concerning the date of initial treatment, the highest number of dead trees was recorded for late spring, then for early spring, summer and the lowest for winter treatments equalling 99.3% (149 out of 150 trees), 97.3% (146 out of 150

Table 1. The share of dead black cherries after four seasons of mechanical control in the Kampinos National Park. Each experimental variant consists of 25 trees

Treatment	Plot	Share of dead trees [%]					
		date of initial treatment				total	
		spring*	spring**	summer	winter		
Cutting at the base	Sieraków	100	100	100	64	91	84
	Lipków	88	100	76	44	77	
Cutting at 1 m above ground	Sieraków	100	100	100	60	90	88
	Lipków	100	100	80	64	86	
Girdling	Sieraków	96	96	100	64	89	85.5
	Lipków	100	100	100	28	82	
Total		97.3	99.3	92.7	54.0	85.8	85.8

* – early spring, ** – late spring.

Table 2. Percentage share of black cherry trees or stumps with sporocarps of macroscopic fungi in the fourth season of control, depending on the type and date of the mechanical treatment on two experimental plots in Kampinos National Park

Treatment	Plot	Share of trees or stumps with sporocarps [%]					
		dates of initial treatments in 2015/2016				total	
		spring*	spring**	summer	winter		
Cutting at the base	Sieraków	52.00	60.00	48.00	84.00	61.00	63.50
	Lipków	40.00	88.00	40.00	96.00	66.00	
Cutting at 1 m	Sieraków	100.00	92.00	96.00	96.00	96.00	93.00
	Lipków	92.00	100.00	76.00	92.00	90.00	
Girdling	Sieraków	84.00	84.00	96.00	84.00	87.00	83.00
	Lipków	72.00	92.00	68.00	84.00	79.00	
Total	Sieraków	78.67	78.67	80.00	88.00	81.33	79.83
	Lipków	68.00	93.33	61.33	90.67	78.33	

* – early spring, ** – late spring. Each experimental series consists of 25 trees per plot.

trees), 92.7% (139 out of 150 trees) and 54% respectively (81 out of 150 trees). Due to the type of treatment, the differences in the number of dead trees are also very small: out of 200 trees, 176 were dead when the trunk was cut at a height of 1 m, 171 when the tree was girdled and 168 were dead when cutting at the base, equalling ca. 88%, 85.5% and 84% respectively.

With the exception of the winter treatment (without removal of sprouts), the share of dead trees is 100% or close to it. The most different from others is the group of trees subjected to control in summer on the plot in Lipków, where the share of dead trees ranges from 76% to 100%. Among 18 experiment variants with sprouts removal, 13 show 100% of dead trees, 15 more than 90%, and 17 more than 80% of dead trees. Out of 9 variants for each plot, the share of dead trees was 100% for 6 in Lipków and in Sieraków for 7. More than 90% of dead trees showed 6 variants in Lipków and 9 in Sieraków.

In the case of winter treatments, the share of dead trees is lower compared with others and ranges from 28% to 64% depending on the type of treatment and plot (Tab. 1). A lower number of dead trees is found for the plot in Lipków: 34 trees out of 75 versus 47 trees out of 75 in Sieraków, equalling ca. 45% and 62% respectively. Concerning the type of treatment, the lowest number of dead trees was recorded for girdling (23 on 50, i.e., 46%), higher for cutting at the base (27 on 50, i.e., 54%) and the highest for cutting at 1 m above ground (31 on 50, i.e., 62%.)

Occurrence of macrofungi on mechanically treated black cherry trees

Macrofungi sporocarps were found on 479 of 600 black cherry individuals, that is, on almost 80% trees or stumps subjected to mechanical control in 2015/2016. On both plots, a similar number of black cherry individuals with sporocarps of macroscopic fungi were found: 244 – in Sieraków, and 235 – in Lipków, which accounts for ca. 81% and 78% of specimens, respectively (Tab. 2). Comparing the type of treatment, the highest share of black cherry individuals with sporocarps was found on high trunks (93%, 186 of 200 trees) and the lowest on low trunks (63.5%, 127 of 200 trees). In the group of girdled trees, the share of specimens with sporocarps took intermediate value between the abovementioned (83%, 166 of 200 trees). In the respect of the type of treatment, the results for both plots were very similar (Tab. 2). Considering the share of trees with sporocarps due to the date of the treatment,

Table 3. List of species of macrofungi recorded on black cherry subjected to control, in the fourth season after the mechanical treatment, on two experimental plots in Kampinos National Park

Species	Occurrence plot in	
	Sieraków	Lipków
1	2	3
Ascomycota		
Ascocoryne sarcoides (Jacq.) J.W. Groves & D.E. Wilson	+	+
Hypocrea citrina (Pers.) Fr.		+
Nectria cinnabarina (Tode) Fr. (anamorph *Tubercularia vulgaris* Tode)	+	+
Orbilia xanthostigma (Fr.) Fr.	+	
Orbilia eucalypti (W. Phillips & Harkn.) Sacc.	+	+
Pezicula cinnamomea (DC.) Sacc.	+	+
Basidiomycota		
Armillaria ostoyae (Romagn.) Herink	+	+
Basidioradulum radula (Fr.) Nobles	+	
Bjerkandera adusta (Willd.) P. Karst.	+	+
Byssomerulius corium (Pers.) Parmasto	+	+
Chondrostereum purpureum (Pers.) Pouzar	+	+
Calocera cornea (Batsch) Fr.	+	
Coniophora arida (Fr.) P. Karst.	+	+
Coprinellus micaceus (Bull.) Vilgalys, Hopple & Jacq. Johnson (= *Coprinus micaceus* (Bull.) Fr.)	+	
Crepidotus cesatii (Rabenh.) Sacc.	+	
Cylindrobasidium evolvens (Fr.) Jülich	+	+
Dacrymyces stillatus Nees	+	
Daedaleopsis confragosa (Bolton) J. Schrot.	+	+
Exidia plana Donk	+	+
Exidia truncata Fr.	+	
Flammulina velutipes (Curtis) Singer	+	
Fomitiporia punctata (P. Karst.) Murrill (= *Phellinus punctatus* (P. Karst.) Pilát)	+	
Gymnopilus sapineus (Fr.) Maire	+	
Ganoderma lipsiense (Batsch) G.F. Atk. (= *Ganoderma applanatum* (Pers.) Pat.)	+	+
Heterobasidion annosum (Fr.) Bref.	+	+
Hyphoderma setigerum (Fr.) Donk	+	+
Hypholoma fasciculare (Huds.) P. Kumm.	+	+
Hypochnicium wakefieldiae (Bres.) J. Erikss.	+	+
Laxitextum bicolor (Pers.) Lentz	+	+
Mycena galericulata (Scop.) Gray	+	+
Mycena leucogala (Cooke) Sacc.	+	+
Mycena sanguinolenta (Alb. & Schwein.) P. Kumm.	+	
Panellus serotinus (Pers.) Kühner	+	+
Peniophora cinerea (Pers.) Cooke	+	+
Peniophora incarnata (Pers.) P. Karst.		+
Peniophora lycii (Pers.) Höhn. & Litsch.	+	+
Phanerochaete velutina (DC.) P. Karst.	+	+
Peniophorella pubera (Fr.) P. Karst.		+
Phlebia radiata Fr.	+	+
Phlebia tremellosa (Schrad.) Nakasone & Burds.	+	+
Phlebiopsis ravenelii (Cooke) Hjortstam	+	
Plicaturopsis crispa (Pers.) D.A. Reid	+	
Polyporus tuberaster (Jacq. ex Pers.) Fr.		+
Steccherinum ochraceum (Pers. ex J.F. Gmel.) Gray	+	
Stereum hirsutum (Willd.) Pers.	+	+
Stereum rugosum Pers.	+	+
Tomentella terrestris (Berk. & Broome) M.J. Larsen	+	+
Trametes ochracea (Pers.) Gilb. & Ryvarden	+	+
Trametes versicolor (L.) Pilát	+	+
Trechispora cohaerens (Schwein.) Jülich & Stalpers		+
Xylodon flaviporus (Berk. & M.A. Curtis ex Cooke) Riebesehl & E. Langer	+	+

+ – denotes the occurrence of particular taxa the highest share was found after late spring and winter treatments, 86% (129 of 150 trees) and 85.3% (128 of 150 trees) of trees respectively, and the lowest share after summer and early spring treatments, 70.66% (106 of 150 trees) and 73.33% (110 of 150 trees) of trees respectively. In this case, the results for both plots were more diverse than those relating to the type of treatment (Tab. 2).

Fungi whose sporocarps were found on mechanically controlled black cherries, belong to 51 macroscopic species, including 45 Basidiomycota and 6 Ascomycota species (Tab. 3). A slightly higher number of species (46) was found on the plot in Sieraków than on the plot in Lipków (37). Both plots shared 32 species, 12 species occurred only on the plot in Sieraków, and 4 only on the plot in Lipków (Tab. 3). On the plot in Sieraków, among 47 species, 5 are Ascomycota and 41 Basidomycota, while in Lipków for 37 species, 5 are Ascomycota and 32 Basidiomycota.

Only four species of macroscopic fungi were found on 50 reference black cherries designated in 2018 (Tab. 4.). Their sporocarps appeared on dead or dying branches. On the plot in Sieraków, two recorded species of fungi occurred on three trees, and on the plot in Lipków, on four trees there were found four species of fungi.

Table 4. List of macrofungi species found on reference trees of black cherry on two plots in Kampinos National Park

Species	Occurrence on reference trees	
	plot in	
	Sieraków	Lipków
Basidioradulum radula (Fr.) Nobles		+
Trechispora cohaerens (Schwein.) Jülich & Stalpers		+
Hyphoderma setigerum (Fr.) Donk	+	+
Peniophora cinerea (Pers.) Cooke	+	+

+ – denotes the occurrence of particular taxa

In addition, several species of macroscopic fungi, which have not yet been recorded within the frame of the ongoing project, were found on lying branches, logs and overturned trees of black cherry (i.e., on trees not included in the experiment but occurring within the plots). They were, among others: *Hapalopilus nidulans* (Fr.) P. Karst. and *Hymenochaetopsis tabacina* (Sowerby) S.H. He & Jiao Yang, both recorded in Sieraków.

It is also worth mentioning that on both research plots, disease symptoms were found on black cherry

Table 5. Group of the most abundant macrofungi on black cherry specimens in the fourth season of control on two experimental plots in Kampinos National Park

Species	Plot	Colonized specimens of black cherry			
		number of trees	share [%]	total	
				number of trees	share [%]
Ascomycota					
Nectria cinnabarina (Tode) Fr. (anamorph *Tubercularia vulgaris* Tode)	Sieraków	23	7.7	63	10.5
	Lipków	40	13.3		
Basidiomycota					
Armillaria ostoyae (Romagn.) Herink	Sieraków	2	0.7	74	12.3
	Lipków	72	24.0		
Bjerkandera adusta (Willd.) P. Karst.	Sieraków	71	23.7	115	19.2
	Lipków	44	14.7		
Chondrostereum purpureum (Pers.) Pouzar	Sieraków	16	5.3	45	7.5
	Lipków	29	9.7		
Hyphoderma setigerum (Fr.) Donk	Sieraków	68	22.7	129	21.5
	Lipków	61	20.3		
Hypholoma fasciculare (Huds.) P. Kumm.	Sieraków	22	7.3	40	6.7
	Lipków	18	6,0		
Hypochnicium wakefieldiae (Bres.) J. Erikss.	Sieraków	18	6.0	31	5.2
	Lipków	17	5.7		
Peniophora cinerea (Fr.) P. Karst.	Sieraków	54	18.0	95	15.8
	Lipków	41	13.7		
Stereum hirsutum (Willd.) Pers.	Sieraków	23	7.7	54	9.0
	Lipków	31	10.3		
Stereum rugosum Pers.	Sieraków	12	4.0	24	4.0
	Lipków	12	4.0		
Trametes versicolor (L.) Pilát	Sieraków	19	6.3	33	5.5
	Lipków	14	4.7		

leaves caused by *Monilia seaveri* J.M. Reade and *Phyllactinia corylea* (Pers.) P. Karst. (= *P. guttata* (Wallroth) Léveillé). Both pathogens have not been reported from KPN so far.

Among the identified 51 macrofungi species, 11 that occurred on more than 20 specimens of black cherry are shown in Table 5. The most common on mechanically controlled black cherry trees was *Hyphoderma setigerum* recorded on 129 individuals representing 21.5% (Tab. 5). On both plots, the frequency of occurrences of this species was similar: in Sieraków, it was recorded on 68 individuals, and in Lipków, on 61 individuals, which accounts for ca. 23% and 20% respectively.

The second species of fungus, due to the number of colonized black cherry specimens, was *Bjerkandera adusta*, which was found on 115 individuals representing ca. 19%. Much more specimens with sporocarps of that fungus were found on the plot in Sieraków (on 71 individuals representing 23.66%) than in Lipków (44 individuals representing 14.66%).

The next four species of macrofungi with a significant number of findings are: *Peniophora cinerea* (on 95 individuals representing 15.83%), *Armillaria ostoyae* (on 74 individuals representing 12.33%), *Nectria cinnabarina* (on 63 individuals representing 10.5%) and *Stereum hirsutum* (on 54 individuals representing 9%).

Another five species of fungi occurred on black cherry in the range from 20 to 50 trees, representing 3.33% to 8.33% respectively: *Chondrostereum purpureum*, *Hypholoma fasciculare, Hypochnicium wakefieldiae*, *Stereum rugosum*, *Trametes versicolor.* Thirteen other species of fungi occurred over a dozen or so individuals of black cherry and the occurrence of the remaining species did not exceed 10 trees.

Discussion

In the conditions of Central Poland, on the habitats of coniferous forests and mixed pine forest, black cherry loses to a great extent the ability to generate new sprouts after 4 years of control, irrespective of the date and type of initial treatment but under condition that the sprouts were consequently removed at least once at the end of each growing season.

This does not mean that the effectiveness of the treatments expressed with other measures such as the number or length and weight of the shoots and the dying out dynamics do not differ considering the date and type of control (Otręba et al. 2016; Marciszewska et al. 2017).

It is also worth noting that the percentage of stumps and trees with sporocarps exceeds on average 80%, and winter treatments do not stand out, as one would expect assuming the effect of macrofungi on black cherry dying dynamics. However, this does not exclude macrofungi involvement in the dying out process, as the percentage of trees and trunks with sporocarps may be the result of the presence of trees in different stages, that is, weakened, dying and already dead in case of winter treaded-trees. In that case, taxa characteristic of the initial and later stages of colonization can be found here making the overall number higher than expected in the first place.

The lowest percentage of fungal colonization was recorded for stumps resulting from the cut at the base, which can be considered consistent with expectations as the area available for colonization is the very basic limitation. This is also in line with the results obtained by Baranowska et al. (2019) showing that the collection of fungi of larger black cherry stumps was more diverse and more numerous than on stumps with a smaller diameter.

In the above mentioned research, the majority of the analysed wood samples were dominated by Ascomycota, while Basidiomycota dominated only in the case of samples collected in the winter, which may to some extent explain the discrepancy with our results. In our study, the taxa recorded, based on the sporocarps surveyed in late autumn, were mainly Basidiomycota species (45), and only very few were Ascomycota (6). However, methodological aspects may significantly weigh on these results as the molecular methods used in the abovementioned research give a wider possibility of taxa identification without the presence of sporocarps.

Compared to 2016 with 26 taxa of macrofungi recorded on black cherry specimens (Marciszewska et al. 2017), the number of taxa found in 2018 is almost twice as high. On the plot in Sieraków, the number of taxa increased by 25 compared to 21 species found in 2016. This number consists of 28 new taxa and 7 taxa, which were then confirmed and are currently not present, that is: *Ascocoryne cylichnium*, *Gloiothele citrina*, *Hohenbuehelia atrocaerulea*, *Mycena haema-*

topus, *Phaeotremella pseudofoliacea*, *Resinicium bicolor*, *Vuilleminia coryli*. On the plot in Lipków, 20 taxa more than in 2016 (18 species) were found: 23 taxa were new, while 3 taxa were not found, that is: *Basidioradulum radula*, *Hohenbuehelia atrocaerulea*, *Radulomyces confluens*.

A comparison of the species composition of fungi with the highest frequency in the second and fourth season of control shows that only one species *Bjerkandera adusta* occurs with an equally high frequency in both cases. This is may be due to the ecological properties of this species. *B. adusta* is involved in lignocellulose decomposition after colonization by primary and secondary colonizers. It belongs to fungi with a mixed competition (C) and ruderal (R) life-history strategy and participates in the relatively early and late stages of wood decomposition (Boddy and Heilmain-Clausen, 2008). Most of fungi that dominated one year after the initial treatment are pioneer colonizers as wound parasites (*Chondrostereum purpureum*, *Stereum rugosum*) or saprobic on freshly exposed wood (*Cylindrobasidium evolvens, Coniophora arida*). After four seasons of the experiment, the group of dominant species consisted of secondary colonizers (e.g., *Hyphoderma setigerum*, *Bjerkandera adusta*, *Stereum hirsutum*) and facultative parasites (e.g., *Armillaria ostoyae*, *Nectria cinnabarina*) (Butin 1995; Żółciak 2003; Boddy and Heilmainn-Clausen 2008).

Of these two groups mentioned above, only *Cylindrobasiudium evolvens*, *Peniphora* sp. and Nectriaceae have been demonstrated in studies based on molecular identification of fungi on black cherry stumps (Baranowska et al. 2019). Although the inventory of fungi in the compared studies is different, the common property is the succession of fungi communities with a predominance of saprotrophs in the later stages of colonization.

The richness of fungi associated with the decaying wood indicates the decomposition process taking place in black cherry stumps and trees. It is very likely that among the species of fungi identified in this study, there is diversity in the ability to decompose black cherry wood. It would be desirable to identify naturally occurring saprotrophs, whose action would reduce the black cherry's offspring potential. In connection with the above research results, we considered it justified to undertake further research related to the above issue, especially in the context of fungi associated with the decomposition of dead wood and to indicate their potential in reducing the occurrence of black cherry.

Conclusions

1. In the conditions of Central Poland, on the habitats of coniferous forests and mixed pine forest, black cherry loses to a great extent the ability to generate new sprouts after four years of control, irrespective of the date and type of initial treatment, but under the condition that the sprouts were consequently removed at least once at the end of each growing season.
2. The share of black cherry stumps and trunks with sporocarps in the fourth year of control was more than three times higher (80% of all specimens) compared to the assessment made in the second year (25% of specimens).
3. The number of species of fungi identified in the fourth year of the experiment on controlled and reference black cherry trees (51, including 4 on reference trees) was almost twice as high as compared to the composition recorded in the second year of the experiment.
4. In the group of dominant fungal species typical secondary colonizers (e.g., *Hyphoderma setigerum, Bjerkandera adusta, Stereum hirsutum*) and faculative parasites (e.g., *Armillaria ostoyae, Nectria cinnabarina*) prevailed in the fourth year of black cherry control.
5. Black cherry turned out to be the host of three species of fungi that have not been found in the Kampinos National Park so far including *Plicaturopsis crispa*, *Monilia seaveri* and *Phyllactinia corylea*.

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