*Mycologist, Volume **18**, Part 1 February 2004. ©Cambridge University Press Printed in the United Kingdom.*
DOI: 10.1017/S0269915X0400103X

Fungi of ornamental woodchips in Surrey

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We report a two year survey of saprotrophic fungi colonising woodchip mulch at two contrasting sites in Surrey, a formal garden and a roadside planting scheme. Two alien species (*Stropharia aurantiaca* and *Psilocybe cyanescens*) occurred at both sites, along with other notable species including *Psilocybe percevalii*, *Agrocybe putaminum* and *Collybia biformis*. Very little fruiting occurred on areas mulched with bark chippings. In the formal garden there was virtually no repeat fruiting in successive years. At the roadside site most species fruited profusely in the first season after deposition, then decreased greatly in numbers in the second year. It is concluded that ornamental woodchips, but not bark chippings, can support diverse fungal communities including unusual species, although these assemblages are short-lived.

Keywords: woodchips, colonisation, *Psilocybe cyanescens*, *Psilocybe percevalii*, *Stropharia aurantiaca*, *Collybia biformis*

The practice of applying chipped woody material as a weed-suppressing mulch to garden beds has become routine gardening practice since the 1980s, creating an ideal habitat for wood-decaying fungi. There have been several reports of unusual fungi growing on this substrate, of which the first was probably *Psilocybe cyanescens* growing on woody mulch in the Royal Botanic Gardens, Kew in the 1940s, although this has since been found on woody mulch in Edinburgh botanic gardens, Windsor Great Park and elsewhere (Watling & Gregory, 1987; Watling, 1997; Pegler & Legon, 1998b; Shaw & Kibby, 2001). The most widespread alien encountered on woody mulch is probably *Stropharia aurantiaca*, although its wild habitat remains unclear (Watling & Gregory, 1987; Pegler & Legon, 1998b; Reid & Eiker, 1999; Shaw & Kibby, 2001; Revett, 2002) and this species may be transferred out of *Stropharia* in a future taxonomic review. Other noteworthy species that have been recorded on woodchips include *Agrocybe putaminum* (Pegler & Legon, 1998a), *Clathrus archeri* (Pegler, Laessøe & Spooner, 1995), *Gymnopilus dilepis* (Henrici, 2002) *Psilocybe azurescens* (Gminder, 2001), the first UK records of *Coprinus pachydermis* (Schafer, 2001) and *Melanoleuca verrucipes* (Henrici, 2001). We report surveys of macrofungi fruiting on woody mulch in two ornamental settings in Surrey, with the intention of describing the composition and dynamics of the community.

The main study site (Site One) was at the Royal Horticultural Society Garden, Wisley, Surrey (grid reference TQ065585), a large formal garden containing several hundred individually labelled beds, many of which are mulched with woody material. The mulches are of three compositions: chipped pine bark (bought in), chipped woody material (locally generated from brash then left to compost for 6-12 months), and rotted sawdust used as bedding by the Royal Stables. The composition of the woody materials involved varies according to availability, being an unpredictable mixture of coniferous and broadleaved material, though the locally generated mulch at Wisley will tend to be predominantly broadleaved. There is regular replacement of these mulches, and while it was not feasible to collect individualised mulch replacement histories for each individual bed, it was observed that about a quarter of beds was remulched between surveys and that replacement mulches often differed from their predecessors. It was impossible to ascertain the broadleaf/coniferous mixture used in these mulches.

Site Two was at TQ166587, consisting of 4 beds around a roundabout (at the junction of the A244 and Oaklawn road) which had been deeply mulched with woodchips immediately after construction in July 1999 but left unmanaged thereafter. The woodchips came from a commercial supplier in Essex who did not record

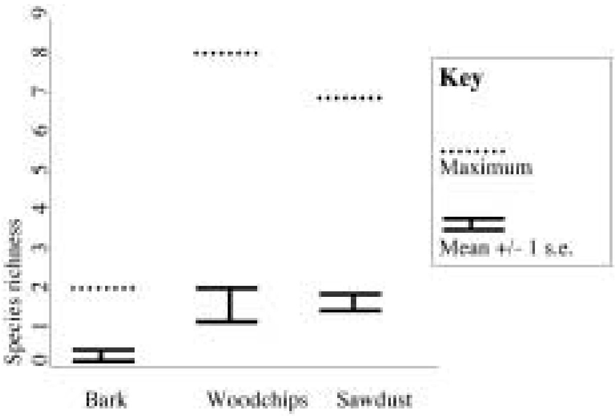

Fig 1 Species richness (mean +/- standard error and maximum) on each mulch type in site one, The Royal Horticultural Society gardens at Wisley. The species richness differed significantly between substrates (p<0.01 by the Kruskal-Wallis test).

their origin or composition beyond being produced in the UK. Site Two was surrounded by oak woodland on two sides and wooded residential grounds on the other two. Both sites were surveyed on a 2-weekly basis from September to November 2000 and 2001, in addition to less frequent ad-hoc inspections during the summer months. Saprotrophic species were recorded by date and bed number. In 2000, mulch was taken from 50 randomly selected beds from Wisley for particle size analysis (by sieving).

There were 39 species identified from Site 1 (Wisley). Table 1 lists the number of beds that each was identified from (broken down by substrate type - sawdust, chipped woody material or chipped bark). Total fungal records were 43 (on 27 sawdust beds), 189 (on 194 woodchip beds) but only 14 from the 100 bark chip beds, a highly non-random distribution ($chi^2 = 86.2$ with 2df, $p < 0.001$). No species was most frequently found on bark beds, and only *Mycena*

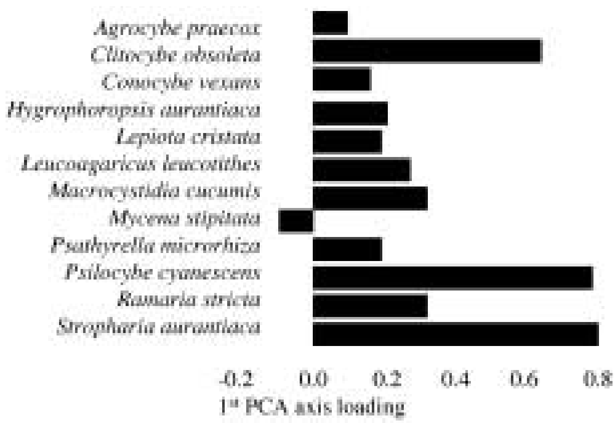

Fig 2 Eigenvector loadings for the first principal axis of the commoner fungi (>4 observations) in the ornamental beds at Wisley.

stipitata was routinely found on this material. Sawdust and woodchips held similar communities, although the three records of *Psilocybe coprophila* were all in the sawdust beds. Species richness was lowest on the bark-mulched beds, both in terms of the mean and maximum richness (Fig 1). Species richness was negatively correlated with % coarse particles (defined as particles >4.7mm) ($r_s = -0.42$, df = 48, $p<0.01$). The commonest fungi overall were *Psathyrella microrhiza* (69 records), *Stropharia aurantiaca* (32 records) and *Psilocybe cyanescens* (28 records). This dataset includes the first published record of *Collybia biformis* from the UK, although this species is widespread in the forests of northern America. *Ramaria stricta* produced unusually large and vigorous fruit bodies (20 cm high and often covering several square metres for many weeks) with rather smaller spores than is usual (8µmx4µm), and may prove to be a different species. The sawdust used at Wisley comes with stable manure so would be expected to yield copropilous species, although in fact the only specifically coprophilous fungus recorded was *Psilocybe coprophila*.

In an attempt to uncover community structure, these data were ordinated by principal components analysis (PCA), including only the twelve species recorded four times or more. The first axis only accounted for 18.2% of the variation, which is less than would be expected for random noise under the broken stick model (Jackson, 1993), suggesting the data to be poorly structured. The first eigenvector loadings are presented in Fig 2, showing all species (except *M. stipitata*) to have positive loadings, of which the greatest values were those of *P. cyanescens* and *S. aurantiaca*. This can be interpreted as showing a weakly structured community (with a particular tendency for *P. cyanescens* and *S. aurantiaca* to co-fruit), while *M. stipitata* fruited separately. Simple correlation analysis confirmed that the best predictor of *P. cyanescens* fruiting was the occurrence of *S. aurantiaca*, and vice versa. With only one exception (*Agaricus sylvaticus* in one bed) the same fungi were never recorded from the same bed in two successive years. In many cases this can be attributed to the mulch having been changed in the intervening year, but this cannot be the sole explanation since the mulch remained unchanged in over half of the beds.

Observations from Site 2 are summarised in Table 2, showing 16 species including *Psilocybe percevalii* (reported by Watling and Gregory (1987) as 'rarely encountered', with no previous records on the BMS database) and the second published UK record of *Agrocybe putaminum*, a north American species first recorded on woodchips in Kew gardens (Pegler & Legon

Table 1. Fungi found in woody mulch at The Royal Horticultural Society garden at Wisley (Site One) during 2000 and 2001, showing the number of beds in which each species was found. Maximum possible totals would be 27 (Sawdust), 194 (Woodchips) and 100 (Bark).

Species	S	W	B		S	W	B
Agaricus sylvaticus Sch:Fr	1	2	0	*Gyromitra esculentea* (Pers:Fr) Fr	0	2	0
Agrocybe praecox (Pers:Fr) Fayod	0	7	1	*Hygrophoropsis aurantiaca* (Wülf: Fr) Maire	2	2	0
Armillaria mellea (Vahl: Fr) Kummer	0	1	1	*Kuehneromyces mutabilis* (Scop: Fr) Smith&Singer	0	1	0
Clitocybe nebularis (Batsch:Fr) Kummer	0	1	0	*Lepiota aspera* (Pers:Fr) Bon	1	0	0
Clitocybe obsoleta (Batsh:Fr) Quélet	2	4	0	*Lepiota cristata* (Bolt: Fr) Kummer	1	5	1
Clitocybe odora (Bull:Fr) Kummer	1	0	0	*Lepista nuda* (Bull:Fr) Cooke	1	2	0
Collybia maculata (Alb&Schw:Fr) Quélet	0	1	1	*Leucoagaricus leucotithes* (Vittadini) Wasser	0	3	1
Collybia biformis (Peck) Singer	1	1	0	*Lycoperdon pyriforme* Sch:Pers	1	0	0
Conocybe tenera (Sch:Fr) Kühner	2	1	0	*Macrocystidia cucumis* (Pers:Fr) Josserand	1	5	0
Coprinus atramentarius (Bull:Fr): Fr	0	1	0	*Mycena stipitata* (Fr) Maas & Schwöbel	0	10	5
Conocybe vexans Orton	1	4	0	*Panaeolus subbalteatus* (Berk. &Br.) Sacc.	1	0	0
Coprinus lagopus Fr	0	2	0	*Panaeolus rickenii* Hora	0	1	0
Coprinus micaceus (Bull:Fr) Fr	0	2	0	*Psathyrella cf microrhiza* (Lasch:Fr) Konrad & Maublanc	4	62	3
Coprinus picaceus (Bull:Fr) SF Gray	0	1	0	*Psilocybe coprophila* (Bull ex Fr) Kummer	3	0	0
Cyathus olla (Batch:Prs) Pers	1	1	0	*Psilocybe cyanescens* Wakefield	3	25	0
Cyathus striatus (Huds:Pers) Willdenow	0	1	0	*Ramaria stricta* (Pers:Fr) Quélet	3	9	0
				Stropharia caerulea Kriesel	1	2	0
Entoloma sp.	1	4	1	*Stropharia aurantaica* (Cooke) Imai	12	20	0
Geastrum triplex Junghuhn	0	1	0	*Volvariella gloiocephela* (Decand.:Fr) Boekhout & Engel	0	1	0
Gymnopilus penetrans (Fr:Fr) Murrill	0	3	0	*Xylaria hypoxylon* (L: Fr) Greville	0	1	0

Abbreviations: S - Sawdust, W - woodchips, B - Bark

1998a). With one exception (*Tarzetta catinus*, which first appeared in 2001) the over-riding pattern was a dense fruiting in 2000 followed by a weaker emergence, if any at all, in 2001.

These data show that finely chipped woody material may support a community of unusual saprotrophic fungi including several alien species, but suggest that fruiting is short-lived. There was no evidence of repeat fruiting at Site One (Wisley RHS garden), although regular replacement of the mulch obscures the picture. At Site Two there was some repeat fruiting in the second year, but both numbers and species richness were reduced. A pile of woodchips represents a rich resource for suitable fungi, and one which (unlike an intact log) presents no physical barriers to rapid hyphal penetration. Consequently it is reasonable to expect resource competition to be rapid and intense (Boddy, 2000). The composting process generates heat, although it is not clear whether temperatures rise high enough to switch the decomposer community to one temporarily dominated by thermophiles. The dramatic, dense emergence of fruiting bodies on recently deposited woodchips has been remarked on by Revett (2002), describing *Cyathus striatus* co-fruiting with *Coprinus lagopus*, *Macrocystidia cucumis*, *Ramaria stricta* (recorded above), plus *Mutinus caninus*, *Entoloma*

Table 2. Fungi from Site Two, woodchip mulch applied to a roadside planting scheme.

Species	Comment
Abortiporus biennis (Bull:Fr) Singer	Found in the same spot in one bed both years.
Agrocybe praecox (Pers:Fr) Fayod	Prolific in two sites in 2000, not relocated in 2001.
Agrocybe putaminum (Maire) Sing	Prolific in two beds in 2000, with a small flush in a third site in 2001.
Conocybe inocybeoides Watling	Small numbers in both years in different beds.
Conocybe vexans	Found profusely in three beds in 2000, re-appearing in smaller numbers in two places in 2001.
Coprinus micaceus (Bull:Fr) Fr	Small numbers in one bed in 2001
Gymonopilus hybridus (Sow: Fr) Maire	One bed in 2001
Hyphaloma fasciculare (Huds: Fr) Kummer	Small numbers in two beds in 2000
Lachrymaria lachrymabunda (Bull:Fr) Moser	Small numbers in one bed in 2000, another in 2001.
Pluteus romellii (Britz) Saccardo	One occurrence in 2000
Psathyrella microrhiza (Lasch:Fr) Konrad & Maublanc	Widespread in 2000, greatly reduced in 2001.
Psilocybe cyanescens Wakefield	Fruited in dense clumps in four beds in 2000, re-appearing in smaller numbers in the same locations within these beds in 2001.
Psilocybe percevalii (Berkeley & Broome) Orton	Fruited densely in all beds in 2000, with one small flush in a new location in 2001.
Stropharia aurantaica (Cooke) Imai	Fruited densely in three beds in 2000, greatly reduced numbers in one new location in 2001.
Tarzetta catinus (Holmskj: Fr) Korf & Rogers	One clump appeared in 2001.
Volvariella gloiocephela (Decand.:Fr) Boekhout & Engel	Fruited in two beds in 2000 only.

icterinum and *Helvella lacunosa*. The complete lack of such mass fruitings on bark chips may be explained by the high levels of terpenes and other inhibitory compounds in bark, reducing the quality of the material as a decomposer resource (Kolattukudy & Koller, 1983). What remains unclear is how these fungi initially colonise the mulch. Normal spore colonisation may explain the infection of composting stacks of chipped materials within Wisley garden but seems unlikely to explain the appearance of rare or alien fungi in remote locations such as Site 2, and instead some of these fungi have probably been transported around the countryside in commercial mulch supplies.

Acknowledgements

Thanks are due to The Royal Horticultural Society (especially Chris Prior and Anna Pérez Sierra) for permission to study in their gardens.

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