

SEXUALITY OF *TRAMETES CINGULATA* BERK.

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MATING experiments with fifteen primary mycelia of monosporous origin have revealed that *Trametes cingulata* Berk. is 'heterothallic' and sexually 'tetrapclar'. Four principal types of reactions, namely, 'compatible', 'neutral', 'antagonistic' and 'inhibitory' have been noticed during pairings of primary mycelia and these have been described in detail. A compatible pair always produces a secondary mycelium showing clamp-connexions.

INTRODUCTION

Investigations on the phenomenon of heterothallism in Basidiomycetes are steadily increasing in India, and in this laboratory have been carried out on a number of species by Banerjee and his co-workers (1954, 1955, 1956a, 1956b, 1957, 1958). *Trametes cingulata* Berk. is another fungus of the series under study. *Trametes cingulata* is a common wood-destroying Polyporaceae of tropical and subtropical India. It is evident from the available literature (Whitehouse, 1949; Quintanilha and Pinto-Lopes, 1950; Raper, 1953) that no work has so far been done on the sexual phenomenon of this fungus. An attempt has, therefore, been made to throw some light on the nature of heterothallism existing in *Trametes cingulata*.

MATERIAL AND METHODS

With a view to determine the sexual behaviour of *Trametes cingulata* fifteen monosporous mycelia were derived from a single sporophore. The surface of a cleared, filtered and sterile agar in a Petri dish was flooded with a dilute spore-suspension in sterile distilled water and allowed to stand for a few minutes. The water was then poured off. In this way, several other plates were also prepared. These were then incubated at room temperature (30°C.) for 10 to 12 hours and finally examined. The lid of the Petri dish was removed and well-germinated and isolated spores were then punched out as small agar discs, each containing a single germinating spore, by means of a sterile cutter and transferred to 2.5% malt-agar slants. In all cases, mycelia developed within the tubes and after careful examination they were all found to be in the primary condition and without clamp-connexions.

Fifteen monosporous cultures were then paired in all possible ways on 2.5% malt-agar slants (pH 6) in culture tubes and were allowed to grow for a month. At the end of the period, the line of contact between the paired mycelia as well as the unpaired ones was carefully examined for the presence of clamp-connexions. The results of these examinations are recorded in the Tables 1 and 2.

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Table 1. Pairings of 15 monosporous mycelia derived a single sporophore of *Trametes cingulata*

	AB				ab				Ab				aB			
	1	4	10	15	3	7	11	12	2	6	9	13	14	5	8	
AB	1	-	-	-	+	+	+	+	-	-	-	-	-	-	-	
	4	-	-	-	+	+	+	+	-	-	-	-	-	-	-	
	10	-	-	-	+	+	+	+	-	-	-	-	-	-	-	
	15	-	-	-	+	+	+	+	-	-	-	-	-	-	-	
ab	3	+	+	+	+	-	-	-	-	-	-	-	-	-	-	
	7	+	+	+	+	-	-	-	-	-	-	-	-	-	-	
	11	+	+	+	+	-	-	-	-	-	-	-	-	-	-	
	12	+	+	+	+	-	-	-	-	-	-	-	-	-	-	
Ab	2	-	-	-	-	-	-	-	-	-	-	-	-	+	+	
	6	-	-	-	-	-	-	-	-	-	-	-	-	+	+	
	9	-	-	-	-	-	-	-	-	-	-	-	-	+	+	
	13	-	-	-	-	-	-	-	-	-	-	-	-	+	+	
	14	-	-	-	-	-	-	-	-	-	-	-	-	+	+	
aB	5	-	-	-	-	-	-	-	+	+	+	+	+	-	-	
	8	-	-	-	-	-	-	-	+	+	+	+	+	-	-	

Table 2. Pairings of 15 monosporous mycelia derived from a single sporophore of *Trametes cingulata* showing different types of reactions.

	AB				ab				Ab				aB			
	1	4	10	15	3	7	11	12	2	6	9	13	14	5	8	
AB	1	N	N	N	N	C	C	C	C	I	I	I	I	A	A	
	4	N	N	N	N	C	C	C	C	I	I	I	I	A	A	
	10	N	N	N	N	C	C	C	C	I	I	I	I	A	A	
	15	N	N	N	N	C	C	C	C	I	I	I	I	A	A	
ab	3	C	C	C	C	N	N	N	N	A	A	A	A	I	I	
	7	C	C	C	C	N	N	N	N	A	A	A	A	I	I	
	11	C	C	C	C	N	N	N	N	A	A	A	A	I	I	
	12	C	C	C	C	N	N	N	N	A	A	A	A	I	I	
Ab	2	I	I	I	I	A	A	A	A	N	N	N	N	C	C	
	6	I	I	I	I	A	A	A	A	N	N	N	N	C	C	
	9	I	I	I	I	A	A	A	A	N	N	N	N	C	C	
	13	I	I	I	I	A	A	A	A	N	N	N	N	C	C	
	14	I	I	I	I	A	A	A	A	N	N	N	N	C	C	
aB	5	A	A	A	A	I	I	I	I	C	C	C	C	N	N	
	8	A	A	A	A	I	I	I	I	C	C	C	C	N	N	

(+) — Clamp-connexion
(-) — No clamp-connexion

N — Neutral
C — Compatible
A — Antagonistic
I — Inhibitory

RESULTS

From the Tables it will be observed that mycelia 1, 4, 10 and 15 paired with mycelia 3, 7, 11 and 12 and mycelia 2, 6, 9, 13 and 14 paired with mycelia 5 and 8 in such a way that they formed clamp-connexions; but other combinations exhibited 'neutral', 'inhibitory' and 'antagonistic' behaviours. This indicates that *Trametes cingulata* is 'heterothallic' and exhibits 'tetrapolar' type of sexuality. The four groups can be designated as AB, ab, Ab and aB. The mycelia 1, 4, 10 and 15 (AB) are complementary and compatible with mycelia 3, 7, 11 and 12 (ab). Again, the mycelia 2, 6, 9, 13 and 14 (Ab) are compatible and complementary with mycelia 5 and 8 (aB).

In all, four principal types of reactions are noticed from the interactions of primary mycelia of *Trametes cingulata* as stated below:

Compatible—Two primary mycelia intermingle freely, eventually lose their identity, and secondary mycelium with clamp-connexions is formed at the line of contact which tends to grow upwards forming a raised mat. There is no line of aversion and the agar medium is not discoloured below their place of contact.

Neutral—Two primary mycelia merge into one another forming a homogeneous mat. The secondary mycelium with clamp-connexions is not formed. The medium below the mat is also not discoloured.

Antagonistic—Two primary mycelia meet to form a distinct line of aversion separating the two interacting colonies. In some cases, however, a narrow space of aversion is formed and this space is filled with their intermingling mycelia. Neither secondary mycelia nor clamp-connexions are present. A dark zone in the agar medium is formed just below the line of separation.

Inhibitory—Two primary mycelia remain separated from each other and appear to be antagonistic in nature, bearing a clear wide space between them. As there is no intermingling between the interacting hyphae, secondary mycelium with clamp-connexions cannot be formed. There is also discolouration of the medium just below the separation zone.

DISCUSSION

From the behaviour of the interacting primary mycelia it is clear that, *Trametes cingulata* shows tetrapolar type of sexuality. In a tetrapolar species the mycelia derived from the four spores of a basidium belong to four different sex groups. It has been assumed that in this case there are two allelomorphic pairs of sex factors in the fusion nucleus of a basidium and genetically four different types of nuclei are derived due to reduction division of the synkaryon in the basidium, that is, the tetrapolar species are able to pair in such a way as to form dykaryotic mycelia due to the "occurrence and independent assortment of allelomorphic determining factors at the two genetic loci". These factors are designated as *A*, *a* and *B*, *b*. As a result of reduction division of the synkaryon, four daughter nuclei are derived which may have the genetic constitution as *AB*, *Ab*, *aB* and *ab*. Matings between mycelia forming dikaryotic stage will only take place between complements so as to restore a double heterozygote, namely, *AB* × *ab* and *Ab* × *aB*.

The behaviour of such heterothallic forms is unique in the sense that the combinations of strains, such as, *AB* × *Ab*, *aB* × *ab*, *AB* × *aB* or *Ab* × *ab*, fail to produce the typical heterozygote for the initiation of dikaryon. Here are observed two distinct kinds of reactions which have been described as 'antagonism' and 'inhibition'. Inhibition may be defined as an extreme case of antagonism leaving a wide space of aversion between them. In a typical example of antagonism where similar incompatibility between interacting mycelia is observed, the space of aversion is absent or greatly reduced. This difference in the behaviour of the incompatible mycelia may have the following cytological explanation. The combination of strains where heterozygosity (*ABab*) is disturbed due to the presence of the same factor in allelomorphs (*A* or *a*) cause inhibition as in *AB* × *Ab* or *aB* × *ab*. On the other hand, the combinations where heterozygosity is disturbed due to the presence of the factor *B* or *b*, the result is antagonism as in *AB* × *aB* or *Ab* × *ab*.

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REFERENCES

- Banerjee, S. N. (1956a). Heterothallism in *Auricularia auricula-judae* (Linn.) Schroet. *Sci. and Cult.*, **21**, 549-50.
- Banerjee, S. N. and Mukherjee, N. (1954). Homo-heterothallism in *Marasmius campanella* Holterm. *Sci. & Cult.*, **19**, 618.
- Banerjee, S. N. and Sinha, A. K. (1955). Sexuality of *Polystictus sanguineous* (L.) Mey. *Sci. & Cult.*, **20**, 564-65.
- Banerjee, S. N. and Sanyal, S. (1956b). Studies on Heterothallism III. *Lentinus subnudus* Berk. and *Lentinus praerigidus* Berk. *Indian J. mycol. Res.*, **2** (1 & 2), 74-75.
- Banerjee, S. N. and Samadder, K. R. (1957). Studies on Heterothallism II. *Polystictus xanthopus* Fr., *Sci. and Cult.*, **22**, 578-79.
- Banerjee, S. N. and Sarkar, A. (1958). Studies on Heterothallism IV. *Ganoderma lucidum* (Leyss.) Karst. *Sci. & Cult.*, **24**, 193-195.
- Quintanilha, A. and Pinto-Lopes, J. (1950). La Conduite des especes d'Hymenomycetes. *Boletim da sociedade Broteriana*, **24**, 115-290.
- Raper, J. R. (1953). Tetrapolar Sexuality. *Quart. Rev. Biol.*, **29**, 233-59.
- Whitehouse, H. L. K. (1949). Heterothallism and Sex in Fungi. *Biol. Rev.*, **24**, 411-47.

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