

Variation in Sporulation in *Trichoderma viride* Pers. ex Fries¹

O. G. WEGRICH, Commercial Solvents Corporation, Terre Haute

The genus *Trichoderma* was founded in 1794 by Persoon, the first species described being *T. viride*. Some confusion in the nomenclature of this genus arose during the next few years, but Fries reduced to synonymy the names he considered to belong to *T. viride* Pers. ex Fries.

Lindau compiled thirteen names in the genus *Trichoderma* but remarked that all but *T. viride* were doubtful because the method of spore formation was unknown in the other twelve.

The most recent work on the taxonomy of *Trichoderma* was done by Bisby (1) in 1939. Bisby considered *Trichoderma* a monotypic genus, which is in accordance with Persoon and Fries.

The antibiotics gliotoxin and veridin were isolated from strains of *T. viride* by Weindling (4) and Brian et al (2). These antibiotics were obtained from yellow pigment-forming strains. Weindling (5) and others have also demonstrated the toxic action of *Trichoderma* on *Rhizoctonia* sp. and other soil fungi.

During the war, strains of *Trichoderma* were found to be the cause of much deterioration in military equipment in the Southwest Pacific. Isolates have been obtained from shelter halves, tent canvas, pistol belts, synthetic rubber raincoats, and other military items. The Biological Laboratory of the Philadelphia Quartermaster Depot is investigating the industrial significance of these observations.

Conidia of the three strains investigated usually germinate in a bipolar manner. The conidia at first swell to a globoid form, 6-10 microns in diameter; a germ tube then arises by the extrusion of protoplasm through a pore in the spore wall. A second germ tube, arising in the same manner as the first, but from the opposite side of the spore, soon appears. Usually, however, the second germ tube does not exceed 50 microns. The spore, by the time the second germ tube appears, is globoid in form, thin walled, and hyaline. Within 12 hours vacuolation is evident within the hyphae. Such vacuolation seems to be instrumental to the formation of septations. Conidiophores arise within 48 hours and are not sharply distinct from the vegetative hyphae. The conidiophores are usually branched, sometimes unbranched; the branches are often whorled, arising at approximately 90° from the conidiophore or parent hyphae. Hyphae may terminate in phialides. Young phialides lack a firm wall, but this develops from the base upward. A septum forms at the base as the phialide matures; this septum is perforated by a pore at first but apparently closes soon after the conidia formation. At the time of spore formation, the phialides are bowling pin shaped and arise singly, opposite, or in whorls. Each phialide is surmounted by a head of conidia which are held together by slime. Under conditions of high humidity, conidia

¹ Paper from the Department of Biology of Purdue University.

from two or more phialides, may coalesce to form a common head, or they may form in a catenate manner (Plate I).

Conidia arise by the extrusion of protoplasm through the neck of the phialide. After developing a firm wall, each conidium is cut off from the apex of the phialide. With the formation of the next conidium, the mature conidium is forced from the phialide into the slime ball that has formed at the apex of the phialide. The slime ball may increase in size until it contains several hundred spores.

Chlamydo spores are intercalary or terminal; constrictions, 6-10 microns apart, form in vegetative hyphae; a large vacuole appears between the constrictions; the delimited area swells and round off, and a heavy wall then forms. Upon germination, chlamydo spores give rise to vegetative hyphae that develop into colonies similar to the parent culture.

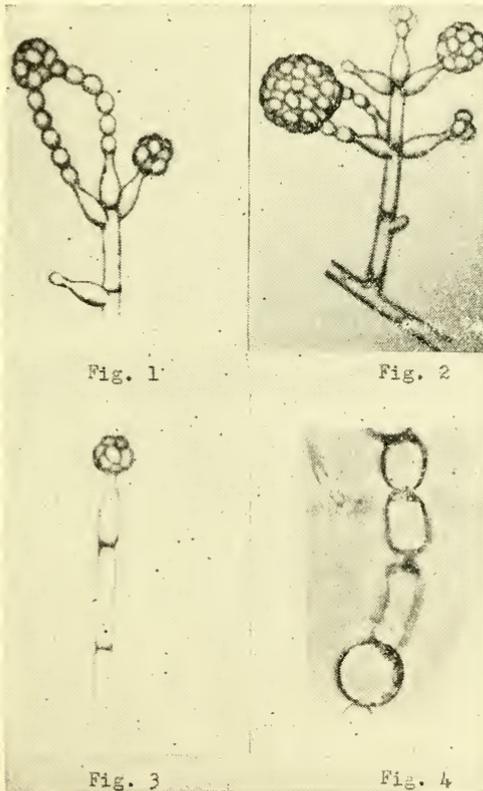


PLATE I. Variation in sporulation in *T. viride*.

Fig. 1, spores borne in a catenate manner. Fig. 2, spores from two phialides coalesce. Fig. 3, spores borne terminally on an unbranched conidiophore. (Figures 1, 2, and 3 are semi-diagrammatic drawings.) Fig. 4, chlamydo spore formation. (Photomicrograph.)

Under conditions of high humidity, the typical *Trichoderma* habit of sporulation is variable. The sporulating habit is normally described as, viz. (1), "conidiophore branched, phialides bearing terminally the conidial heads." Under conditions of high humidity (94-96%), the spores from two or more phialides may coalesce to form a single spore mass that is held together by slime. This is an important taxonomic characteristic of the genus *Gliocladium*. Also the spores may be borne in a catenate manner, or terminally on an unbranched conidiophore, the later is a *Cephalosporium* characteristic. However, if observations are made on cultures grown in a culture chamber of about 50 per cent relative humidity, the typical *Trichoderma* sporulation habit is obtained.

Moist chambers were prepared for this work in the manner described by Spencer (3).

The finding reported in this paper supports, in part, the finding of Bisby (1) on spore formation and variation in *Trichoderma viride* Pers. ex Fries.

References

1. Bisby, G. R. *Trichoderma viride* Pers. ex Fries, and notes on *Hypocrea*. Transactions of the British Mycological Society, 23: Part II, 1939.
2. Brian, P. W., P. J. Curtis, H. G. Hemming, and J. C. McGowan. The Production of Viridin by Pigment-forming Strains of *Trichoderma viride*. The Annals of Applied Biology, 33:190-200, 1946.
3. Spencer, H. M. Laboratory Methods for Maintaining Constant Humidity. International Critical Tables, 1:67-69. New York and London. 1926.
4. Weindling, R. The Isolation of a Toxic Substance from the Culture Filtrates of *Trichoderma* and *Gliocladium*. Phytopathology, 27:1175-1177, 1937.
5. Weindling, R. *Trichoderma lignorum* as a Parasite of other Soil Fungi. Phytopathology, 22:837, 1932.