

MORPHOLOGY AND MODE OF GERMINATION OF
CONIDIA OF *HELMINTHOSPORIUM ORYZAE* IN
RELATION TO ITS TAXONOMY

By

S. B. CHATTOPADHYAY AND M. K. DASGUPTA*

*Department of Plant Pathology, Faculty of Agriculture, Kalyani University,
West Bengal*

The conidia of the different species of the genus *Helminthosporium* exhibit considerable variation in morphology as well as in mode of germination. Basing on the shape of conidia and mode of germination, Nisikado (1928) proposed two sub-genera namely, *Cylindro-Helminthosporium* and *Eu-Helminthosporium*. The species with cylindric conidia germinating from any cell were placed in *Cylindro-Helminthosporium*, while those with fusoid conidia germinating only from two polar cells were termed *Eu-Helminthosporium*. Ito (1930) proposed the genus *Drechslera* to include those species of the *Helminthosporium* (*Cylindro-Helminthosporium* of Nisikado) which have cylindric conidia and germinate from any cell. Hughes (1949) noted the variation in method of formation of conidium in different species and considered this character to be more fundamental than the shape of conidia and mode of germination. In some species, the conidia are formed both apically and laterally while in others, specially in graminicolous ones only at the apex where new apex is produced by subterminal growth and formation is continued in succession. Shoemaker (1959) proposed a new genus *Bipolaris* for those species under *Helminthosporium* which have fusoid or conidia and exhibit bipolar germination. The description of the *Bipolaris*, as proposed by Shoemaker (1959) is as follows :

Conidiophores brown, producing conidia through an apical pore and forming a new apex by the growth of the subterminal region. Conidia fusoid, straight or curved, germinating from one germ tube from each end; exosporium smooth, rigid, brown; endosporium hyaline, amorphous, separating cells of mature phragmospores. Parasite chiefly on Gramineae. Perfect state, where known in *Cochliobolus Drechsleri* Phytopath. 24, 973 (1934).

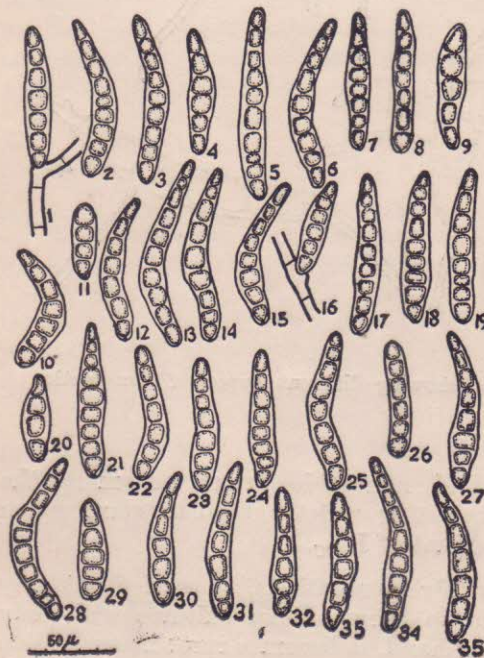
Luttrell (1954, 1963, 1964) discussed the taxonomy, systematics and criteria of classification in *Helminthosporium* and related genera. He recognized the taxonomic importance of the mode of germination, but proposed to retain the earlier nomenclature of *Helminthosporium* instead of *Bipolaris* (Luttrell, 1964).

Helminthosporium oryzae Breda de Haan [perfect state *Cochliobolus miyabeanus* (Ito & Kuribay) Dickson], the incitant of the Brown spot

* Present address: Plant Pathology Section, Palli Siksha Sadan, Visva-Bharati, West Bengal.

disease of rice is widely distributed in different parts of the world. The earlier workers, Drechsler (1923), Mitra (1931), Chattopadhyay and Chakrabarti (1952) noted considerable variations in morphology of conidia.

The present investigators studied a large number of isolates of *Helminthosporium oryzae* with particular reference to morphology, mode of formation and germination of conidia. The morphology of conidia was studied as occurring on the host and also on maize meal agar and oat meal agar. The conidia range from $10-25\mu \times 45-120\mu$ in size, being short or long, straight, cylindric, fusoid or curved near the base or tip, number of septa ranging from 3-11, the individual cells of the conidia mostly being isodiametric or longer than wide although still shorter cells are not uncommon. Other types of variation or atypical conidia are occasionally found even within a single isolate. (TEXT FIGS. 1-35).



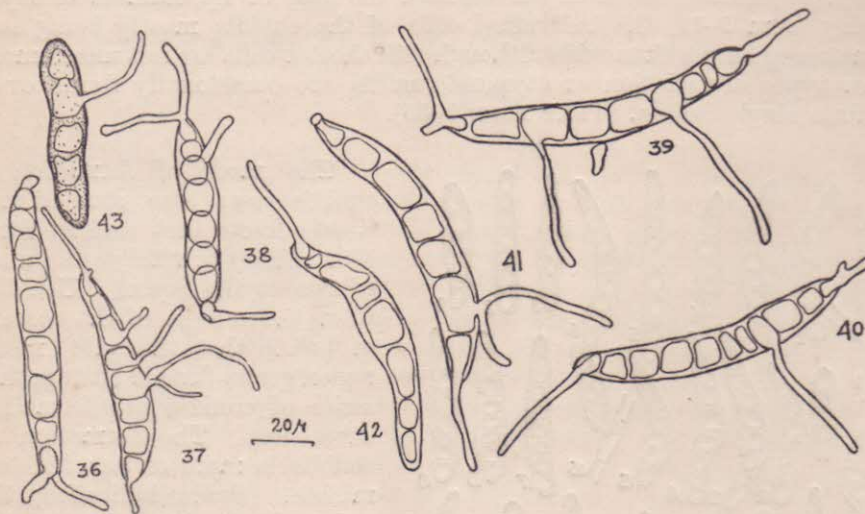
TEXT FIGS. 1-35: Types of variation in conidial morphology within a single isolate (vide Text)

considered unviable, where no indication of germination could be noted even after ten hours of culture under such conditions. In most of the isolates, germination was strictly bipolar. But in a few isolates, the germination showed a different pattern. In these isolates, conidia were usually fusoid, having 5-9 septa, size $11-19\mu \times 55-88\mu$, cells usually longer than wide or isodiametric, i.e., being the more common type in morphological nature. Here, the conidia germinate through the polar cells one following the other usually with a single semiaxial germtube at first, however, later may be accompanied by one or more germtubes from

The mode of formation of conidia was also studied and it was found that conidia form either singly or rarely as a bunch of two at the apex. Usually, after the release of the conidia or before that the subterminal region grows further and another series of conidia are formed in succession. The formation of conidia is more or less indeterminate. Scars indicating the point of attachment with the conidiophore on the terminal cell of the conidia are often pronounced.

The mode of germination was studied in distilled water under the microscope in cavity slides. At room temperature ($25-28^{\circ}\text{C}$.) the germination was evident with production of germtubes within 2-3 hours, in majority of the cases and rarely later than four hrs. The conidia were

both ends. After a slight growth of the germ-tubes from the polar cells, germination is also noticed in one to three intermediate cells. TEXT-FIGS 37-41 Number of germ-tubes per cell vary from one to two. Strictly bipolar germination was also noticed in a number of conidia of such isolates and germination from one polar cell alone was occasionally noted. (TEXT-FIG. 42). Germination from intermediate cells alone was rare. In this case, only one intermediate cell has been found to germinate, but not the polar cells. (TEXT-FIG. 43). No morphological difference could



TEXT FIGS. 36-43: Germinating conidia showing different types of germination (vide Text)

be assigned either among viable and nonviable group, or among the conidia belonging to isolates demonstrating strictly bipolar germination and those following a free type as that of H_{39C} .

Monoconidial culturing for four or five generations, as carried out only in one of such isolates (H_{39C}) failed to bring out subcultures with only 'free type' germination. On the other hand, it becomes rarer in successive generations. This 'free type' was more frequently noted in wild or fresh isolates, but frequency gradually decreased with successive generations. The monopolar germination was occasionally noted in wild types or subcultures, as well as in isolates showing strictly bipolar germination.

Drechsler (1923) noted that immature conidia may germinate from intermediate cells. The question of maturity is not rigid in H_{39C} . Mature conidia also germinate from intermediate cells. Mature and immature conidia are identical in this behaviour.

The pathogenicity test was carried out on Dular variety or rice and the isolate (H_{39C}) was found to be highly pathogenic. Fully developed spots were eye-shaped, 4-5 mm. \times 2-3 mm. in average, sharp in outline,

without a halo, dull brown, colour being uniform without a darker margin. The fresh isolate as well as the subcultures did not differ much either in pathogenicity or in spot morphology.

It is evident that in *Helminthosporium oryzae* there is wide variability in shape, size, and septation of conidia produced on host as well as on artificial media. The bipolar germination as well as the number of germ-tubes per germinating cell which have been considered to be generic characters have not been found to be constant. In view of long usage of the binomial, *H. oryzae* and uncertainty of the characters such as morphology, and mode of germination of conidium, there is no reason why *H. oryzae* should be renamed as *Bipolaris oryzae*. It is to be considered in view of the findings whether the unstable characters like the shape of conidia, mode of germination or number of germ-tubes per germinated cell of conidia should be considered as enough for the creation of a new genus, *Bipolaris*. Emphasis should be laid on the method of conidium formation as has been suggested by Hughes (1948) and any revision of the genus should be made in a comprehensive manner as has been pointed out by Luttrell (1964).

REFERENCES

- Chattopadhyay, S. B. and Chakrabarti, N. K. (1952). Variation in conidial characters of *Helminthosporium oryzae* Breda de Haan. *Proc. 39th Indian Sci. Cong.* (Abstract).
- Drechsler, C. (1923). Some graminicolous species of *Helminthosporium*: I. *J. agri. Res.*, **24**, 641-740.
- Hughes, S. J. (1949). Studies on micro-fungi—II. *C.M.I. Mycological Paper No. 31*, 1-32.
- Ito, S. (1930). On some new ascigerous stages of the species of *Helminthosporium* parasitic on cereals. *Proc. Imp. Acad. Tokyo*, **6**, 352-355.
- Luttrell, E. S. (1954). Approaches to the classification of *Helminthosporium* species. *Plant Disease Reporter, Suppl.*, **228**, 111-113.
- Luttrell, E. S. (1963). Taxonomic criteria in *Helminthosporium*. *Mycologia*, **55**, 643-674.
- Luttrell, E. S. (1964). Systematics of *Helminthosporium* and related genera. *Mycologia*, **56**, 119-132.
- Mitra, M. (1931). A comparative study of species and strains of *Helminthosporium* on certain Indian cultivated crops. *Trans. Brit. mycol. Soc.*, **15**, 254-293.
- Nisikado, Y. (1928). Studies on the *Helminthosporium* disease of Gramineae in Japan. *Spec. Rept. Ohara Inst. agri. Res.*, **4**, 13.
- Shoemaker, R. A. (1959). Nomenclature of *Drechslera* and *Bipolaris*, grass parasites segregated from *Helminthosporium*. *Canad. J. Bot.*, **37**, 879-887.

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