NUCLEAR DISTRIBUTION IN VEGETATIVE CELLS OF *OPHIOBOLUS GRAMINIS* AND OTHER CEREAL ROOT PATHOGENS*

By S. C. CHAMBERS†

Difficulty is sometimes experienced in distinguishing between *O. graminis* and sterile fungi which form "*Ophiobolus*-like" runner hyphae on cereal roots. However, it is possible that nuclear distribution in mycelium may prove a differential character as different distributions have already been reported for *O. graminis* (Chambers and Flentje 1967) and a cereal root-attacking strain of *Rhizoctonia solani* (Flentje, Stretton, and Hawn 1963). This paper, therefore, describes comparisons of nuclear distribution in *O. graminis* and several other cereal root pathogens including a sterile fungus which formed *Ophiobolus*-like runner hyphae.

Materials and Methods

(i) *Fungi*.—The fungi listed in Table 1 were used.

(ii) *Mycelial Preparations for Nuclear Studies*.—Inoculum of an isolate was placed on Cellophane overlying potato–Marmite–dextrose agar in a Petri dish. After incubation for 2–5 days at 20°C a sector was removed and stained with HCl–Giemsa (Robinow 1945) adapted from the method described by Hrushovetz (1956).

(iii) *Counts and Measurements*.—Nuclei of an isolate were counted in 200 cells from each of three sources: hyphae near periphery of a colony and hyphal tips both peripheral and internal. The same cells were measured with a calibrated eyepiece micrometer.

Results

Details of counts and measurements are given in Table 1. These results demonstrate that *O. graminis* differed from all other fungi, including the sterile isolate, in that it had fewer nuclei per cell. In particular, *O. graminis* tip cells were predominantly uninucleate whereas those of other fungi were generally multinucleate. Considerable differences in nuclear distribution also occurred between other species.

Discussion

Results indicate that nuclear distribution is a useful adjunct for distinguishing between *O. graminis* and other cereal root pathogens, including sterile fungi which form *Ophiobolus*-like runner hyphae. Results also showed that species of *Fusarium* differed considerably from one another in nuclear distribution. This is of significance, especially in view of taxonomic problems which have resulted in widespread usage

* Manuscript received May 15, 1970.

† Victorian Plant Research Institute, Burnley, Vic. 3121.

Aust. J. biol. Sci., 1970, **23**, 1105–07

of two different classifications (Wollenweber and Reinking 1935; Snyder and Hansen 1940, 1941, 1945) for the genus. Nuclear distribution was similar in the morphologically related *Curvularia* spp. and *Helminthosporium sativum* and is, therefore, of no value for differentiating between them.

TABLE 1

SIZE AND NUCLEAR NUMBER OF CELLS OF SEVERAL FUNGI

Fungus	Length of Cells (μm)		Width of Cells (μm)	No. of Nuclei/Cell	
	Mean	Range		Mean	Range
		Peripheral tip cells			
Ophiobolus graminis	97·47± 4·65	22–224	2·32±0·05	1·2±0·04	1–2
Unknown (sterile)*	63·79± 3·02	14–152	2·08±0·03	4·1±0·17	1–11
Curvularia ramosa	177·42± 5·66	38–311	2·72±0·06	13·8±0·63	4–33
C. spicifera	113·70± 6·66	12–294	2·64±0·05	11·4±0·67	1–24
Fusarium avenaceum	209·50±10·48	36–492	3·36±0·09	3·0±0·20	1–10
F. culmorum	127·92± 6·55	30–428	3·12±0·05	8·6±0·36	2–19
F. graminearum	141·06± 7·72	35–444	4·00±0·09	21·5±1·39	3–69
Helminthosporium sativum	174·19± 4·63	37–306	3·12±0·06	12·9±0·50	2–28
Wojnowicia graminis	152·29± 5·73	50–324	3·52±0·07	15·8±0·71	4–38
		Internal tip cells			
Ophiobolus graminis	24·72± 1·70	10–127	2·16±0·05	1·1±0·02	1–2
Unknown (sterile)*	25·63± 1·10	9–65	2·29±0·07	2·2±0·12	1–7
Curvularia ramosa	88·85± 5·59	14–308	2·64±0·06	8·5±0·53	1–28
C. spicifera	71·86± 5·36	14–218	2·48±0·04	6·2±0·50	1–27
Fusarium avenaceum	41·78± 1·98	10–104	2·64±0·05	2·2±0·10	1–6
F. culmorum	68·59± 3·11	11–156	3·28±0·07	5·9±0·33	1–16
F. graminearum	60·92± 3·69	16–226	3·92±0·09	8·6±0·54	1–23
Helminthosporium sativum	60·58± 4·43	9–184	2·80±0·06	3·9±0·30	1–15
Wojnowicia graminis	37·48± 1·79	10–86	2·72±0·06	3·4±0·22	1–15
		Internal non-tip cells			
Ophiobolus graminis	33·70± 1·94	8–111	2·56±0·07	1·2±0·05	1–4
Unknown (sterile)*	25·45± 0·57	9–68	2·06±0·04	3·8±0·32	1–18
Curvularia ramosa	47·41± 1·50	17–94	3·28±0·10	5·4±0·24	1–11
C. spicifera	40·60± 1·50	15–83	2·80±0·05	4·2±0·21	1–12
Fusarium avenaceum	42·31± 2·22	4–114	3·20±0·08	1·9±0·10	1–5
F. culmorum	53·18± 2·51	17–206	3·60±0·06	5·3±0·28	2–13
F. graminearum	46·79± 2·92	11–226	5·44±0·11	5·6±0·40	1–23
Helminthosporium sativum	30·52± 1·06	9–84	3·52±0·06	3·7±0·18	1–10
Wojnowicia graminis	31·23± 1·24	13–82	3·76±0·07	3·4±0·17	1–8

* Forms *Ophiobolus*-like runner hyphae on roots.

Acknowledgments

Grateful acknowledgment is made to Dr. R. Dodman and Mr. R. Price for cultures of unknown (sterile) and *Fusarium graminearum* respectively; and to Miss C. Lardner for invaluable technical assistance. This work was supported by funds from the Wheat Industry Research Council of Australia.

References

CHAMBERS, S. C., and FLENTJE, N. T. (1967).—Studies on oat-attacking and wheat-attacking isolates of *Ophiobolus graminis* in Australia. *Aust. J. biol. Sci.* **20**, 927–40.

FLENTJE, N. T., STRETTON, H. M., and HAWN, E. J. (1963).—Nuclear distribution and behaviour throughout the life cycles of *Thanatephorus*, *Waitea*, and *Ceratobasidium* species. *Aust. J. biol. Sci.* **16**, 450–67.

HRUSHOVETZ, S. B. (1956).—Cytological studies of *Helminthosporium sativum*. *Can. J. Bot.* **34**, 321–7.

ROBINOW, C. F. (1945).—Nuclear apparatus and cell structure of rod-shaped bacteria. Appendix to "The Bacterial Cell" by R. J. Dubos. pp. 355–77. (Harvard Univ. Press.)

SNYDER, W. C., and HANSEN, H. N. (1940).—The species concept in *Fusarium*. *Am. J. Bot.* **27**, 64–7.

SNYDER, W. C., and HANSEN, H. N. (1941).—The species concept in *Fusarium* with reference to section Martiella. *Am. J. Bot.* **28**, 738–42.

SNYDER, W. C., and HANSEN, H. N. (1945).—The species concept in *Fusarium* with reference to Discolor and other sections. *Am. J. Bot.* **32**, 657–66.

WOLLENWEBER, H. W., and REINKING, O. A. (1935).—"Die Fusarien." (Paul Parey: Berlin.)