COMPARATIVE CELLULOLYTIC ABILITY OF SOME LITTER-INHABITING FUNGI

by R. S. DWIVEDI *and* V. P. SINGH, *Department of Botany, Banaras Hindu University, Varanasi-5*

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Comparative cellulolytic ability of twenty different litter inhabiting fungi has been assayed *in vitro*. It has been found that these fungi may be classified into three groups depending upon their cellulolytic ability. Group I fungi have the highest cellulolytic ability with a maximum hyphal dry weight production (except three Phycomycetes) while those of Group III have the lowest cellulolytic ability with minimum hyphal dry weight production. Fungi of Group II have medium cellulolytic ability as well as medium hyphal dry weight production.

INTRODUCTION

There are certain reports on the capacity of microfungi to utilise cellulose *in vitro* (Garrett 1962, 1963, 1966; Hogg 1954; Reese and Levinson 1952 and Rai 1969, 1971). Garrett (1966) suggested that the successful saprophytic survival of a fungus largely depends upon its cellulolytic ability. The fungi colonizing plant litter play a very important role in degrading organic matter which remains in a bound and complex form, and in releasing energy rich compounds in the soil. The main object of this paper is to study the capacity of twenty different individual microfungi colonizing the leaf litter of medicinal trees of four species of *Terminalia* viz., *T. tomentosa* Bedd., *T. arjuna* Bedd., *T. chebula* Retz and *T. belerica* Roxb, to utilise cellulose *in vitro*. Only the dominant fungi have been chosen for the present investigation.

MATERIALS AND METHODS

The methods of Garrett (1962) and Reese and Levinson (1952) were followed for the present investigation. Loss in the dry weight of the filter papers reflected the amount of cellulose utilised and did not include the portion converted into fungal substances. The composition of the medium employed (Hogg 1954) was as follows : NH_4NO_3, 1g; KH_2PO_4, 1g; $MgSO_4.7H_2O$, 0.5g; $FeSO_4.2H_2O$, 0.01g; Yeast extract, 0.03g; Macerated Whatman No. 42 filter paper, 10g; Distilled water, 1 litre. The *p*H was maintained to 6.0 by use of H_3PO_4.

To each of one hundred and twenty 500 ml Erlenmyer flasks, was added about 1.3 g wad of oven dry Whatman filter paper No. 44 suspended in 250 ml of the medium. The flasks were autoclaved at 15 lb pressure/square inch for 15 min and then inoculated with individual fungus (listed in Table I). In each case three replicates were inoculated with one agar block of 8mm diameter cut from the periphery of

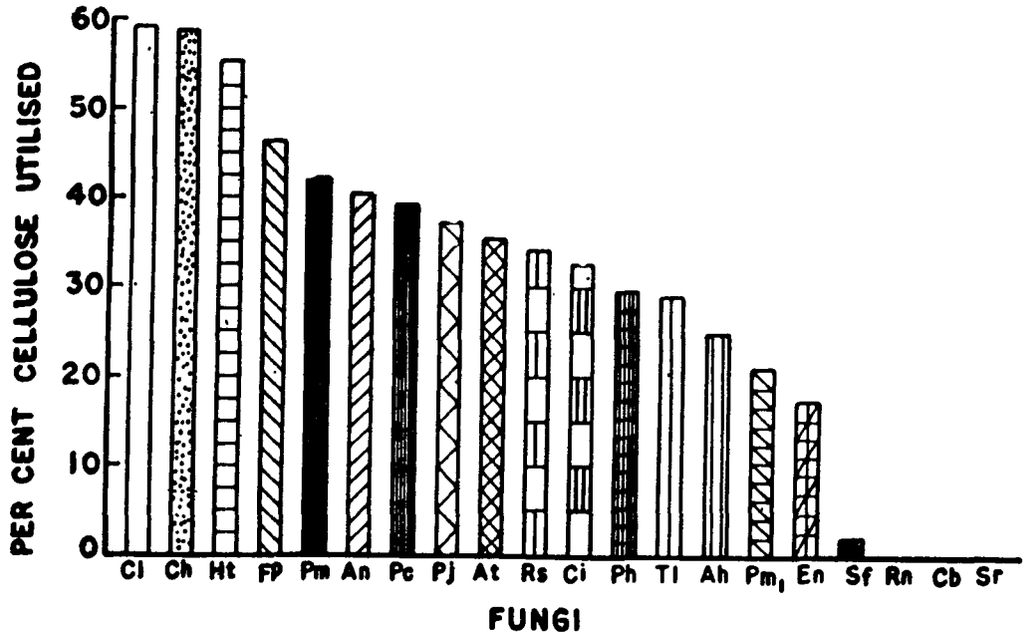

FIG. 1. Histogram showing comparative cellulolytic ability of 20 different litter-inhabiting fungi *in vitro*. Cl = *Curvularia lunata*, Ch = *Cladosporium herbarum*, Ht = *Helminthosporium tetramera*, Fp = *Fusarium poae*, Pm = *Papulaspora magnifica*, An = *Aspergillus niger*, Pc = *Penicillium citrinum*, Pj = *Penicillium javanicum*, At = *Aspergillus terreus*, Rs = *Rhizoctonia solani*, Ci = *Chaetomium indicum*, Ph = *Phoma hibernica*, Tl = *Trichoderma lignorum*, Ah = *Alternaria humicola*, Pm_1 = *Pestalotia macrotricha*, En = *Emericella nidulans*, Sf = *Spicaria fusispora*, Rn = *Rhizopus stonlonifer*, Cb = *Cunninghamella bertholletiae*, Sr = *Syncephalastrum racemosum*.

48 hr old culture of each test fungus and 3 replicates were left uninoculated as control. The flasks were incubated at 25 $\pm$ 1°C for 30 days with a constant daily shaking.

After incubation the filter paper from each flask was taken out, washed in a beaker with distilled water and fungal mycelium removed gently with a scalpel and fine brush. Thoroughly washed filter paper was oven dried at 80°C for overnight. Dry weight loss of each filter paper was noted down. The fungal mycelium removed from the filter paper, was washed in distilled water, oven-dried at 80°C for overnight and weighed. The initial and final *p*H of the medium was also recorded.

RESULTS AND DISCUSSION

Although it is natural to argue that what occurs in Petri dishes or flasks in laboratory on a chemically defined medium is different from what occurs in the naturally decaying litter in competition with other organisms, yet it is demonstrated by the cultural studies (Table I, Fig. 1) that the primary colonizers viz., *R. stolonifer, C. bertholletiae, S. racemosum, C. lunata, C. herbarum, H. tetramera, F. poae, P. magnifica, A. niger, P. citrinum, P. javanicum* and *A. terreus* utilised more cellulose exemplified with more rapid dry weight production of mycelium in comparison to others except the first three species which did not show any mycelial production probably due to lack of production of enzyme cellulase. *R. solani, C. indicum, P. hibernica* and *T. lignorum,* which appeared as dominant colonizers following primary ones, utilised cellulose fairly well but less in comparison to above ones.

TABLE I

Amount of cellulose utilised, yield of mycelial dry weight and final p*H of the nutrient medium of individual microfungus* in vitro

Name of fungal species	Amount of cellulose utilised %	Dry weight of mycelium (mg)	Final *p*H of the medium
Control	–	–	6.0
Group I			
Rhizopus stolonifer	–	–	6.0
Cunninghamella bertholletiae	–	–	6.0
Syncephalastrum racemosum	–	–	6.0
Curvularia lunata	59.2	493.4	6.3
Cladosporium herbarum	58.8	489.6	6.5
Helminthosporium tetramera	55.3	393.3	6.2
Fusarium poae	46.3	322.6	5.8
Papulaspora magnifica	42.3	300.0	4.0
Aspergillus niger	40.5	292.2	6.0
Penicillum citrinum	39.3	283.3	4.7
P. javanicum	37.3	266.7	4.6
Aspergillus terreus	35.6	231.5	5.5
Group II			
Rhizoctonia solani	34.3	208.4	6.5
Chaetomium indicum	32.7	200.0	5.6
Phoma hibernica	29.7	192.8	4.6
Trichoderma lignorum	29.01	165.0	4.1
Group III			
Alterneria humicola	25.01	147.2	6.4
Pestalotia macrotricha	21.2	102.0	5.8
Emericella nidulans	17.5	100.0	6.0
Spicaria fusispora	2.2	21.6	6.0

A. humicola, P. macrotricha, E. nidulans and *S. fusispora,* which were the last and least colonizers on leaf litters, had also the least cellulolytic abiliy as they yielded the least dry weight of mycelium. It may be concluded from the foregoing discussion that the successful colonization of fungi on decaying leaf litters in part may be correlated with their cellulolytic ability. This is in agreement with the observations of Chesters (1960) and Garrett (1966).

Though the members of Group II show ability to utilise cellulose, this characteristic appeared to be of secondary importance as they appeared later than the primary colonizers which have the competitive advantage of appearing on the

litters just after their senescence. Tribe (1966), while working with different cellulolytic fungi, also reported that in the dominance of an individual fungus on a cellulose film, cellulolytic ability appears to be of secondary importance than its individual competitive characteristic.

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REFERENCES

Chesters, C. G. C. (1960). Certain problems associated with the decomposition of soil organic matter by fungi. *In* : The Ecology of Soil Fungi, *ed. by* D. Parkinson and J. S. Waid. Liverpool University Press, Liverpool UK.

Garrett, S. D. (1962). Decomposition of cellulose in soil by *Rhizoctonia solani* Kuhn. *Trans. Br. mycol. Soc.*, **45**, 115–120.

————(1963). A comparison of cellulose decomposing ability in five fungi causing cereal foot rots. *Trans. Br. mycol. Soc.*, **46**, 572–576.

————(1966). Cellulose decomposing ability of some cereal foot-rot fungi in relation to their saprophytic survival. *Trans. Br. mycol. Soc.*, **49**, 57–68.

Hogg, M. B. (1966). Microfungi on leaves of *Fagus sylvatica*. II. Duration of survival, spore viability and cellulolytic activity. *Trans. Br. mycol. Soc.*, **49**, 193–204.

Rai, B. (1969). Comparative cellulolytic ability of some fungi. *Proc. 56th Indian Sci. Cong.*, Part III, 314. (*Abstr.*)

————(1970). Comparative cellulolytic ability of some fungi. Labdev—Journal of Science and Technology, Kanpur (India), B8, 251–252.

Reese, E. T., and Levinson, H. S. (1952). A comparative study of the breakdown of cellulose by microorganisms. *Physiol. Pl.*, **5**, 345–366.

Tribe, H. T. (1966). Interactions of soil fungi on cellulose film. *Trans. Br. mycol. Soc.*, **49**, 457–466.