

ZOOSPORIC FUNGI IN WHEAT FIELDS OF KUMAUN HIMALAYA

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Seventeen species belonging to five genera of zoosporic fungi were isolated from diseased seeds, seedling roots and soils of wheat from different sites of Kumaun Himalaya. A maximum number of species was recorded from Zone A (350-600 m) and minimum from zone C (1200-1800 m). *Achlya diffusa*, Harvey ex Johnson, *A. flagellata*, Coker, *Pythium echinulatum* Matthews, *P. rostratum* Butler, *P. spinosum* Sawada and *P. ultimum* Trow were occurred as parasites of wheat. In inoculation experiments, *A. flagellata* and *P. ultimum* appeared as highly pathogenic caused rotting of seeds and seedling roots in great extent. *A. diffusa* and *P. spinosum* also caused considerable loss, while *P. echinulatum* and *P. rostratum* were mild pathogenic to wheat.

The soil inhabiting zoosporic fungi belonging to Saprolegniaceae and Pythiaceae have been reported from diseased seeds and seedling roots of different economically important plants. Subramanian (1928) was the first who gave an account of root rot of wheat caused by *Pythium graminicolum* Subm. from Bombay, India. Later, several species of zoosporic fungi were reported from different parts of the world as parasites of wheat plants (Vanterpool, 1938; Sharma and Jain, 1967; Kilpatrick, 1968; Lipps and Bruehl, 1978; Waller, 1979; Verma and Khulbe, 1983; Verma 1984).

During the present study on Zoosporic fungi of agricultural crop fields, some species of Saprolegniaceae and *Pythium* were isolated from rotted seeds, seedling roots and soils of different wheat growing fields of Kumaun Himalaya.

MATERIAL AND METHODS

For the present study, the entire Kumaun region has been divided into three altitudinal zones. Eight study

sites viz., Haldwani, Ramnagar, Kashipur (Zone A, altitude 350-600 m), Garampani, Bageshwar, Pithoragarh (Zone B, altitude 600-1200 m), Berinag and Lohaghat (Zone C, altitude 1200-1800 m) were selected on the basis of main wheat growing areas of the Kumaun Himalaya.

Diseased seeds, seedling roots and soils of wheat were collected from selected sites of Kumaun Himalaya. Fungi were isolated from soil samples by using different animal and plant baits as suggested by Middleton (1943) and Johnson (1956). Infected plant parts were washed under running tap water to remove the adhered soil particles, sterilized by 1.0% NaOCl solution for 10 minutes, rinsed, cut into small pieces and plated out on agar plates (Lumsden *et al.*, 1976). Fungi were cultured on boiled hempseed halves, purified and identified with the help of monographs by Coker (1923), Middleton (1943), Johnson (1956), Waterhouse (1968) and Seymour (1970). Some species got

Table 1. Occurrence of zoosporic fungi in wheat fields of Kumaun Himalaya.

Species	Zone A (350-600 m)			Zone B (600-1200 m)			Zone C (1200-1800 m)	
	HAL	KAS	RAM	GAR	BAG	PITH	BER	LOH
<i>Achlya diffusa</i>	S	S, DSR	S	—	—	—	—	—
<i>A. flagellata</i>	S	S, RS	S	S	S	S	—	—
<i>A. prolifera</i>	S	—	S	S	S	S	S	S
<i>A. rodrigueziana</i>	—	S	—	—	—	—	—	—
<i>Brevilegnia diclina</i>	S	S	—	—	S	—	S	S
<i>B. unispetma</i>	—	—	—	—	S	S	—	—
<i>Dictyuchus sterile</i>	S	S	S	S	S	S	S	S
<i>Saprolegnia bhargavii</i>	—	S	S	—	—	—	—	—
<i>S. diclina</i>	S	S	—	S	S	S	—	—
<i>S. subterranea</i>	—	—	—	—	—	—	S	—
<i>P. aphanidermatum</i>	S	—	—	S	S	S	—	—
<i>P. echinulatum</i>	S, DRS	S	S	S	S, DSR	—	—	—
<i>P. inflatum</i>	S	S	—	S	S	—	—	—
<i>P. rostratum</i>	S	S, DSR	S	S	—	—	—	—
<i>P. spinosum</i>	S, DSR	S, DSR	S	—	—	—	—	—
<i>P. torulosum</i>	S	S	S	—	—	—	—	—
<i>P. ultimum</i>	S, DSR	S, RS	S, DSR	—	—	—	—	—

HAL : Haldwani ; KAS : Kashipur ; RAM : Ramnagar ; GAR : Garampani ; BAG : Begeswar ; BER : Berinag ; LOH : Lohaghat ; S : Soil ; DSR : Diseased seedling root ; RS : Rotted seeds and — Absent.

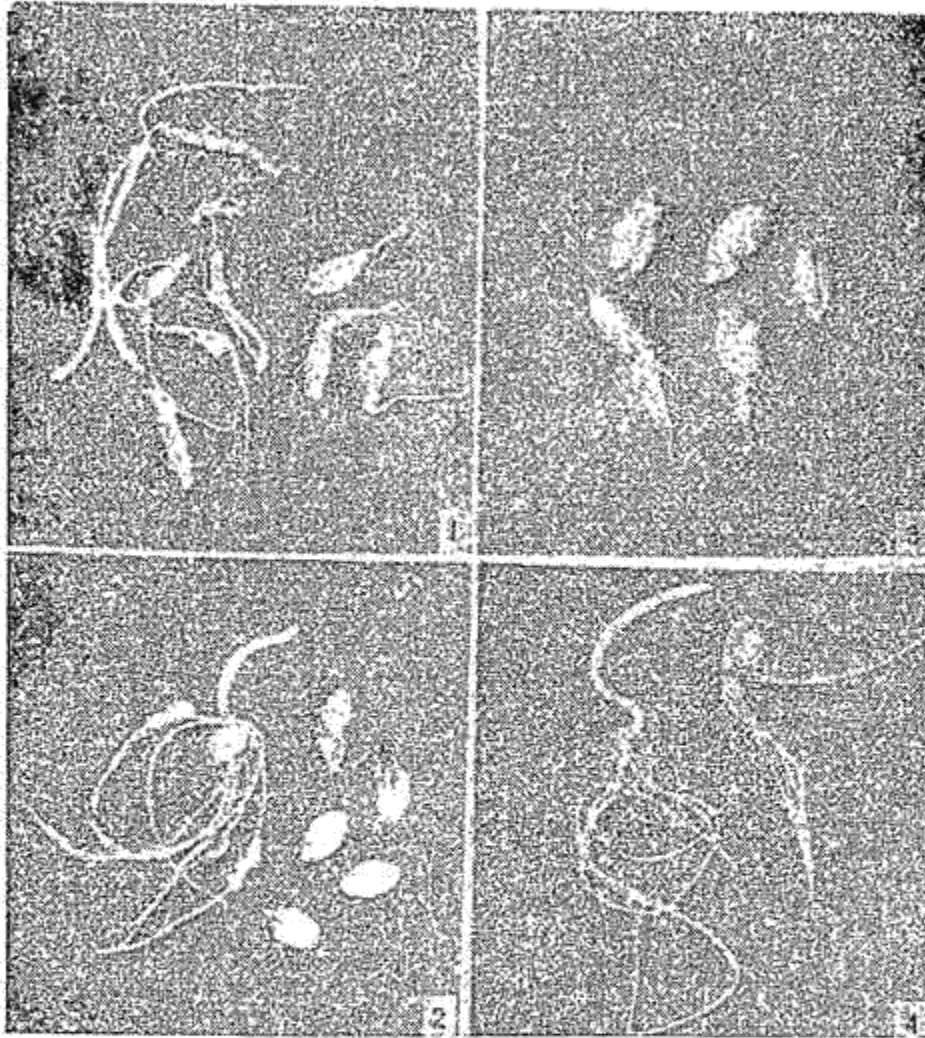
confirmed by the courtesy of the Director, C.M.I. Kew, England.

Pathogenicity tests were carried out on sterile pot soil under glass-house conditions ($20 \pm 3^\circ\text{C}$). These tests were conducted only for those isolated which were recovered from the diseased plant parts in the fields. Test seeds of wheat were surface sterilized by 0.5% mercuric chloride for 5 minutes, washed with sterilized water and sown on infested pot soil of inoculum. In control pots, seeds were sown directly in the soil without inoculum (Webster *et al.*, 1971). All the experimental pots were observed

after every 24 hrs for the germination of seeds, growth of seedlings and fungal infection.

RESULTS AND DISCUSSION

A total of seventeen species belonging to five genera of zoosporic fungi were isolated from rotted seeds. Seedling roots and soils of wheat from different sites of Kumaun Himalaya (Table-1). Of these, maximum number of species was recorded from Zone A having slightly subtropical to tropical climate where temperature ranged between $10-22^\circ\text{C}$ during crop period. Zone B also showed a considerable



EXPLANATION OF THE PHOTO PLATE (Figs. 1-4)

1. Seed and seedlings of wheat infected by *P. ultimum*;
2. White fungal growth over the root surfaces caused by *P. echinulatum*
- 3 Rotted seeds by *A. flagellata*
- 4 Controlled seedlings with healthy roots.

number of species (temp. 8-18°C), while minimum number of species was occurred in the samples of Zone C (temp. 5-14°C). The occurrence of large number of species in Zone A might be due to optimum soil temperature for the germination, survival growth and sporulation of these fungi. Lower temperature in Zone C affected the germination and growth of fungal propagules (Manoharachary, 1981).

Some species showed their restricted occurrence to a particular site or zone. *Achlya diffusa* Harvey ex Johnson, *A. rodrigueziana* Wolf and *Pythium torulosum* Coker et Patterson occurred only in the samples of Zone A and *Saprolegnia subterranea* (Dismann.) Seymour from Zone C. These species were not recovered from other zones or sites. It was very interesting to note that *A. rodrigueziana* occurred once in the wheat field soil of Kashi-pur during the crop season.

Six species viz, *Achlya diffusa*, *A. flagellata* Coker, *P. echinulatum* Matthews, *P. rostratum* Butler, *P. spinosum* Sawada and *P. ultimum* Trow were frequently isolated from diseased seedlings and soils of wheat. The pathogenicity tests also confirmed their parasitic nature to wheat. In inoculation experiments, *A. flagellata* was most severe to seeds and seedlings of wheat. The preemergence rotting of seeds generally noticed which caused the death of germinating seeds and growing plumules and radicles. White mycelial growth appeared over the seed surface after 36 hrs. of inoculation. Verma and Khulbe (1983) reported the heavy loss of wheat seeds and seedlings due to infection of *A. flagellata* both in fields

and inoculation experiments. *A. diffusa* isolated from infected seedling roots also caused infection to seeds in pot soil experiments.

Among the species of *Pythium*, *P. ultimum* and *P. spinosum* appeared as a virulent pathogens of wheat as they completely damaged the germinating seeds and growing seedlings. *P. echinulatum* and *P. rostratum* were, although, mild pathogens of wheat but incited rotting of seedling roots after 8-10 days of inoculation. Surviving seedlings showed yellow brown symptoms over the root surfaces incited wilting of young seedlings. Venterpool (1938) reported a number of *Pythium* species including *P. torulosum* and *P. ultimum* as severe pathogens of wheat. In the present study, *P. torulosum* was occurred only in soil samples. Sharma and Jain (1967), Kilpatrik (1968), Lipps and Bruehl (1978) and Waller (1979) reported several species of *Pythium* as parasites of wheat. Garrett (1970) categorised root infecting fungi into two groups viz., specialized and unspecialised parasites. He kept species of *Pythium* under unspecialized parasitic group having wide host range spread in the soil from one host plant to other very quickly caused infection in early stage of plant growth.

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