

Multifactorial incidence of early blight and its control

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Abstract:

The infected potato plant(about 2 months old) was collected from a field of village Kamarhati, approximately 1 km away from the Saithia-Rampurhat state highway, West Bengal. The disease intensity was measured on the basis of leaf area infected and the average infection was approximately about 30% - 90%. The blight symptoms were apparent though there was a confusion that whether it was early blight or late blight of potato but after isolation, the pathogen was found to be *Fusarium solani*, causing the early blight disease. The microscopic examination of the pathogen showed the presence of appresoria and bulbous haustoria, with an average size of 3.5 μ and 2.25 μ respectively. When grown in potato dextrose agar slants, mycelial ramification occurred after 24hours but after 48 hours clear zonation with central core black and light white margin. Both chlamydospore and conidia were observed after staining, the former had a diameter of 2.4 μ , while the latter was sickle shaped with an average length of 4.2 μ and breadth of 1.2 μ . The reproductive structure also prove that the pathogen was *Fusarium solani*. The Koch's postulate was completed with an average inoculum 2×10^5 spores. Upon testing the effect of a fungicide (carbendazim+mancozeb) and a pesticide (thiodon) for the purpose of disease control it was observed that the first symptoms in the potato tuber appear after 24 hours in the control set, but no infection was observed in case both the treated sets. After 48 hours of infection, there was 96% reduction in infection while complete reduction of disease occurred in case of thiodon. Furthermore it was also observed that ideal infectious condition was observed due to mechanical injury, presence of chlamydospore and high temperature(above 30°C) and humidity above 90%. So it can be concluded that the early blight of potato is a multifactorial disease, which can be controlled when all these factors are absent.

Introduction:

Potato disease is a major problem in our country especially in West Bengal. The infected potato plant (about 60 day old) was collected from a field of village Kamarhati, approximately 1 km away from the Saithia-Rampurhat state highway, West Bengal. This experiment was carried out because of a few problems faced by the people of Birbhum where these potato plants were grown they were: whether the potato was infected with early blight or late blight disease of potato and then control of the disease.

Early blight, caused by the fungus *Fusarium Solani*, can damage both potato foliage and tubers. The disease is also a common problem on tomatoes and eggplant in Alabama. Initial infection usually occurs on the older, lower leaves then progresses up the plant. Lesions first appear as small spots—dry and papery in texture. Lesions become brownish black and circular as they expand. Older lesions often appear angular in appearance as their margins become limited by leaf veins. Leaf tissue immediately adjacent to the lesion is usually yellowed. Tuber lesions are dark, sunken, and circular to irregular in shape, and often are surrounded by a raised purplish-gray border. Late blight of potato is caused by *Phytophthora infestans*. The disease is first seen as damp areas on the lower leaves of plants that may fuse to form a large brown area of dead or damaged tissue. The pathogen grows out from the leaves on the lower surfaces of the leaves where it is seen as a white downy mass. The disease is at most aggressive under damp conditions and will rapidly kill all the aerial parts of a plant. A cycle of infection to sporulation can take as little as four days. If there is a dry period, the disease pauses but will resume when the weather turns damp again. Infected potato tubers show surface damage only, but the damage may allow other microorganisms to enter the tuber and destroy it. The rot can be so severe that entire fields may smell of rotting vegetation.

Materials & Method:

- PDA Slants
- Culture Tubes
- Watch-glass
- Forceps
- 0.1% Mercuric chloride
- Healthy potato tubers
- Cheese-cloth
- Lactophenol cottonblue stain
- Spray bottles
- Fungicide (Carbendazim + Mancozeb)
- Pesticide (Thiodon)

PDA slants were made and the leaves were cut into small pieces containing infected portion. The leaf portions were placed in 0.1% mercuric chloride for one minute and then in sterilized distilled water. Next the leaf pieces were placed in the PDA slants containing the antibiotic streptomycin. The slants were incubated at room temperature for 3-4 days. After appearance of the colony the pathogen was stained for identification.

Next a spore suspension was made and potato tubers were reinoculated with the spores to check disease incidence of the two kinds of spores found.

Finally the previous step was repeated with pesticide and fungicide being sprayed on the two sets.

Results:

Macroscopic Observation :-

The location of the lesion was towards the tip of the leaf with the nature of the lesion being appressed and its colour was dark brown to black, while complete rotting of the leaf occurred after 72hours – 96hours

Percentage of Leaf Infection :-

The percentage of infection in the six infected leaves varied from 30 to 90% and the results are shown in Table 1 and the infected leaves are shown in Fig. 1a and b.

Table 1:

LEAF NO.	INFECTED AREA	LEAF AREA(cm ²)	% OF INFECTION
1	32.4	36	90
2	55.9	57	98
3	35.6	37.4	95
4	9.1	22.75	40
5	6	30	20
6	8.4	28	30

Structure of appressoria and haustoria :-

The appressoria was sickle shaped with it's average size being $3.5 \pm 0.288 \times 1 \pm 0.33$, it's occurrence was 64% while the haustoria was bulbous with it's average size being $2.66 \pm 0.33 \times 1 \pm 0.33$ and it's occurrence was 50%. Results are shown in Table2 and Fig. 2a and b.

Table 2: Structure of appressoria and haustoria :-

Name of the organ	Shape	Dimensions		Percentage
		Length (μ)	Breadth (μ)	
Appressoria	Sickle	3.5 ± 0.288	1 ± 0.33	64%
Haustoria	Bulbous	2.66 ± 0.33	1 ± 0.33	50%

First appearance of Pathogen:-

The mycelial ramification occurred after **24hours** but after **48 hours** clear zonation with central core black and light white margin. (Fig.3)

Microscopic Measurements of Spore:-

The spores of *Fusarium solani* were found to be chlamydospore (Table 3), it's average diameter being $2.4 \pm 0.244 \mu$ and conidia it's average size being $4.5 \pm 0.288 \mu \times 1.25 \pm 0.25 \mu$, while their frequency was 6 and 7 respectively.

Table 3: Microscopic measurements of spore:-

Serial Number	Name of Microorganism	Type	Spore Measurements		Frequency
			Diameter (μ)		
1	<i>Fusarium solani</i>	Chlamyospore	2.4 \pm 0.244		6
2	<i>Fusarium solani</i>	Conidia	Length (μ)	Breadth (μ)	7
			4.5 \pm 0.288	1.25 \pm 0.25	

Reinoculation of potato tuber and disease incidence :-

Upon reinoculation of the potato tubers with chlamyospore and conidia, it was found that the disease incidence was 75% and 84% respectively.(Table 4). The conidia and chlamyospores are shown in Fig. 4.

Table 4 Disease incidence in reinoculated potato tuber :-

Name of microorganisms and type	Diameter (cm)	Radius (cm)	Area (cm ²)	Infected Area (cm ²)	Percentage of infection
<i>Fusarium solani</i> (chlamyospore)	3	1.5	7.07	5.3	75%
<i>Fusarium solani</i> (conidia)	2	1	3.14	2.6376	84%

Effect of fungicide and pesticide on tuber sprayed with spore suspension:-

Upon spraying the potato tubers with the spores and fungicide/ pesticide it was observed that chlamydospore was controlled better using pesticide and conidia was controlled better using fungicide(Table 5 and Fig 5)

Table5: **Effect of fungicide and pesticide on tuber sprayed with spore suspension:-**

SETUP NUMBER	INJURY / WITHOUT INJURY	FUNGICIDE TREATMENT	PESTICIDE TREATMENT	PERCENTAGE INFECTION	
				24 HRS LATER	48 HRS LATER
1 (Chlamydospore)	With injury	No	No	12%	100%
	Without injury	No	No	8%	8%
2 (Conidia)	With injury	No	No	4%	8%
	Without injury	No	No	0%	4%
3 (Chlamydospore)	With injury	yes	No	0%	4%
	Without injury	yes	No	0%	0%
4 (Conidia)	With injury	yes	No	0%	0%
	Without injury	yes	No	0%	0%
5 (Chlamydospore)	With injury	No	yes	0%	0%
	Without injury	No	yes	0%	0%
6 (Conidia)	With injury	No	yes	4%	8%

	Without injury	No	yes	0%	0%
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Discussion:

Majority of these diseases are of mixed nature. Though the symptoms are of late blight but by carrying out the studies we can clearly state that the disease is EARLY BLIGHT DISEASE caused by *Fusarium solani*. Furthermore it was also observed that ideal infectious condition was observed due to mechanical injury , high temperature (above 30°C) and humidity above 90%. Chlamydospore was controlled better using pesticide and conidia was controlled better using fungicide. Single fungicide was not effective against this pathogen. Thiodon shows a non target effect. It can be recommended that insect infestation be controlled in early stages of development of the plant.

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The tabulated data are as follows:

Figures:



Figure 1(a): Healthy Potato leaf



Figure 1(b): Infected potato leaf

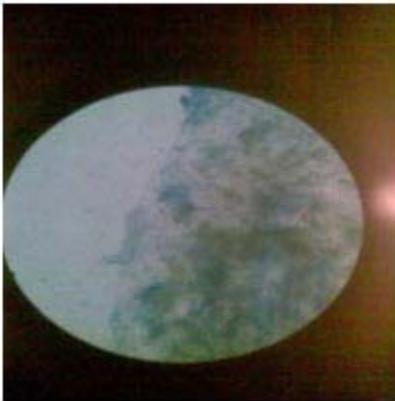


Figure 2(a): Sickle-shaped Appresoria

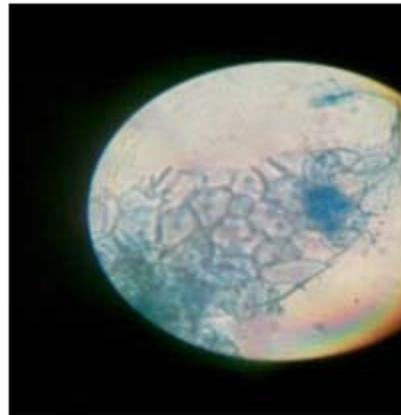


Figure 2(b): Bulbous Haustoria



Figure 3: FIRST APPEARANCE OF PATHOGEN

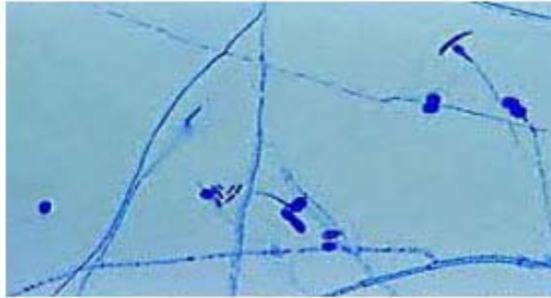


Figure 4(a): Lactophenol cottonblue staining of chlamydospore



Figure 4(b): Lactophenol cottonblue staining of conidia

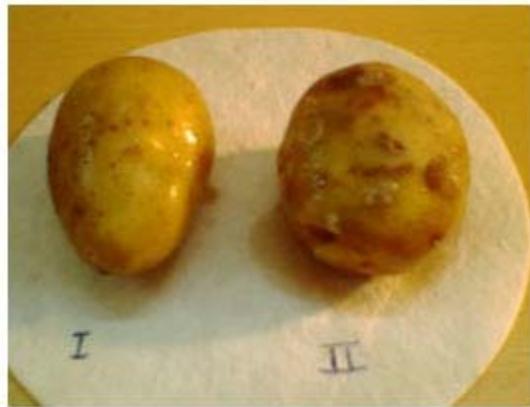


Figure 5(a): Potato tuber inoculated with chlamydospore



Figure 5(b): Potato tuber inoculated with conidia