IMB Part3

Date- 16.4.21

Topic - Plant Disease - (Fungal disease)

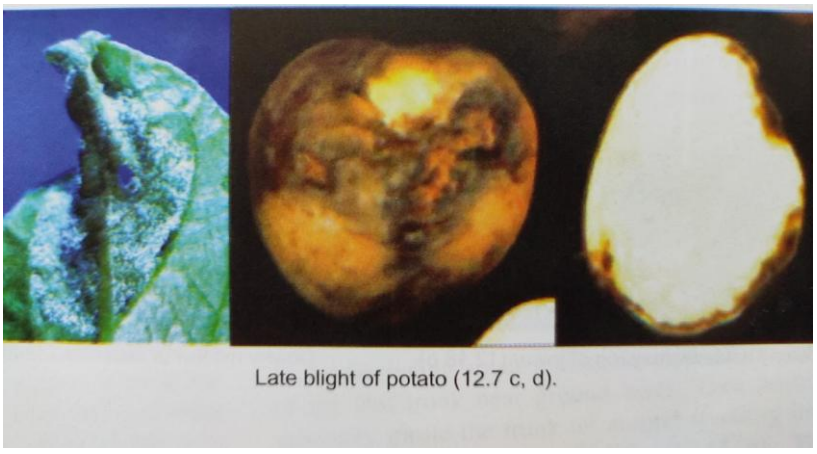
Late blight of Potato

Causal organism*: Phytophthora infestans*

Host*: Solanum tuberosum*

Late blight of potato is a global disease. It is prevalent in moist and cool areas, where potato is grown. It kills the entire plant within two to three days. Complete foliage is destroyed and as a result the tubers cannot develop. This disease was the cause of well known Irish famine in 1840s, when complete loss of potato caused famine nationwide. Potato was introduced from England .The disease travelled through Mexico, Andes and Europe. In India, it first appeared in Nilgiri hills between 1870 and 1880. Soon it was reported from Darjeeling (W. Bengal) which appeared through English potatoes. Initially this was confined to hilly areas in the Himalayan range at the elevation of 11000 ft .but later on it spread to plains of Assam, Bengal, Bihar and northern areas of U.P.

Symptom:- The symptom appears on the leaves by the development of dark green lesions on the upper surface, mostly near the margin. The colour becomes brown. The fungus flourishes well at very low temperature (2-3 C) associated with high humidity. Since the disease appears late in the growing season after flowering, hence named as late blight. Hot dry weather limits the disease development. In dry condition, the infected leaves get curled and become brittle. As a result the leaves break from the plant. In moist condition, the disease spreads rapidly and leaves die with a foul odour. All the leaves and branches become infected if weather is cool and moist. On the underside of infected leaves, the edge of lesions bear fluffy, whitish or greyish downy growth of fungus, which bear sporangiophores and sporangia swinging from stomata. Tubers also get infected in the field when they are attached to the plants.



Late blight of potato (12.7 c, d).

Courtesy: Plant Pathology. (P. D. Sharma, *Rastogi Publ*.)

The causal organism, *Phytophthora infestans* is a fungus belonging to Order Peronosporales, class-Oomycetes of Lower fungi (Phycomycetes). It possesses well branched hyaline, coenocytic mycelia.

The mycelia ramify intercellularly in the host tissue with finger like haustoria. The fungus takes nutrition from host tissue through these haustoria. The fungus produce branched sporangiophores, which emerge through stomata in the lower surface of the infected leaf.

Disease cycle: - The disease spreads to the healthy plants either through lemon shaped sporangia or zoospores. Sporangia are produced on sporangiophores, which swing in the air through stomata of host leaves. These sporangiophores are branched, slender, hyaline and indeterminate. Each sporangiophore produces a sporangium at apex and continues its growth producing subsequent crops of sporangia.

Sporangia are light yellow coloured reproducing units which are multinucleate, thin walled, hyaline, oval, pear or lemon shaped having an apical papilla. Their size ranges from 22-32 x16-24 µm.

Sporangium may germinate directly or it may divide into several smaller units to produce zoospores. Zoospores are reniform, biflagellate motile asexual units which move through water to other healthy potato plants. Their movement is facilitated by irrigational water or rain splashes. Low temperature favours zoospore production, whereas higher temperature favours sporangial germination through germ tubes. The optimum temperature for germination of sporangium is 12C. For the production of sporangia 100% relative humidity is required. In the case of 90% R.H. the sporangia are not produced. Usually it is favoured in the fully saturated atmosphere at 3-22C temperature.

Sexual reproduction – The sexual reproduction is not common. When it is found, it is oogamous type. The male gametangium is known as antheridium and the female gametangium is called oogonium. The antheridium develops earlier than the oogonium. The antheridium is club shaped where as oogonium is pear shaped. The protoplasm of the oogonium is demarcated into two regions, the peripheral area called as periplasm, which is less dense, multinucleate, and the dense granular central region with a single nucleus, is called as ooplasm. The fertilization takes place by fusion of male and female nuclei as a result of piercing of antheridium by the oogonium, which develops later than the antheridium. The resulting diploid structure is called oospore. The oospore has not been found in Indian natural conditions. Oospores are rarely formed due to limited occurrence of compatible mating types. Since the pathogen is heterothallic, the presence of two compatible mating types is necessary for sexual reproduction. Both mating types A_1 and A_2 have been found in other countries, such as Mexico, where oospores frequently develop in leaves.

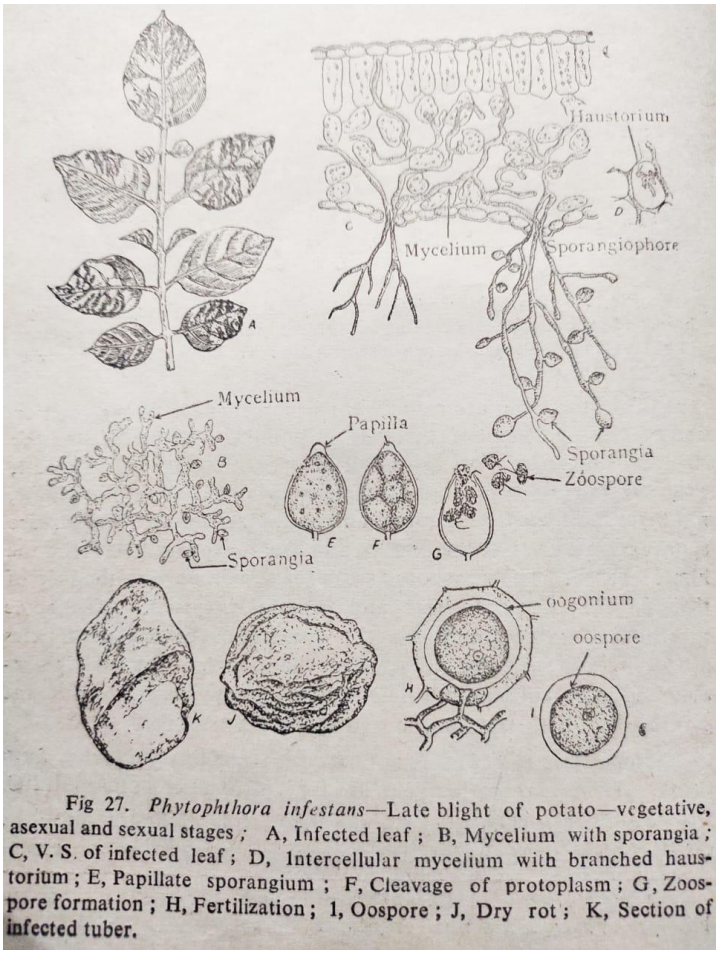


Fig 27. *Phytophthora infestans*—Late blight of potato—vegetative, asexual and sexual stages ; A, Infected leaf ; B, Mycelium with sporangia ; C, V. S. of infected leaf ; D, Intercellular mycelium with branched haustorium ; E, Papillate sporangium ; F, Cleavage of protoplasm ; G, Zoospore formation ; H, Fertilization ; 1, Oospore ; J, Dry rot ; K, Section of infected tuber.

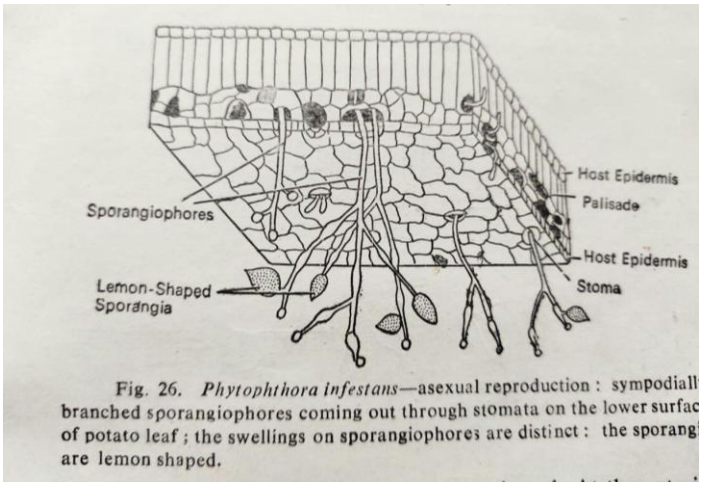


Fig. 26. *Phytophthora infestans*—asexual reproduction : sympodiall branched sporangiophores coming out through stomata on the lower surfac of potato leaf ; the swellings on sporangiophores are distinct : the sporang are lemon shaped.

Fig. Late blight of potato showing different stages of disease caused by *Phytophthora infestans.*

Courtesy: A text book of Botany,B.P.Pandey (Publ.K.Nath & Co. Meerut)

Successful onset of this disease requires two cardinal factors, low temperature at 2-3C and 100% humidity together. The disease outbreak and further spread depends on these two factors.Hence, it is easy to forecast about the onset of late blight of potato on the basis of weather conditions. Four important conditions are important for the spread disease as following-

(i) Night temperature below the dew point for at least four hours

(ii) Minimum temperature 10C os slightly above

(iii) Cloudy weather in the following day

(iv) Rainfall during the successive hours.

Disease spreads to longer distance through sporangia carried through wind and rain. Sporangia may produce zoospores. They move to new tubers through water and infect tubers. Infected tubers give rise to sporangia of fungus, which spread the disease in wider area. Infected tubers are also causal agent of disease in the next season.

In temperate climates, infected tubers left in the field may carry over the living mycelia to next season. In tropical zones, the most common means of infection are infected tubers, which are stored in the cold storage with healthy tubers. In the plains of India, potato season is followed by hot summer. The high temperature kills the fungus in soil and debris, hence, fresh infection begins through diseased potatoes used as seed tubers in the next season.

Disease management- Disease management involves cultural methods, application of fungicides and cultivation of disease resistant varieties.

Disease free seed tubers should be taken for cultivation. Proper sanitation of crop field reduces disease incidence. Diseased plant debris, tubers, etc. should be burnt in the field.

Seed tubers should be treated with mercuric chloride solution (1:1000) before planting. Foliar spray of Bordeaux mixture is effective. Copper fungicides like Fytolon and Blitox-50 have replaced Bordeaux mixture. Dithane Z-78 and Mancozeb (Dithane M-45) are more effective and popular fungicides.

Disease resistant varieties of potato should be used. Some varieties are developed in India are Kufri Naveen, Kufri Jeevan, Kufri Alankar, K.badshah, K. Swarna, K. Khasi Garo, K.Moti and Kufri Moti