

STUDIES ON DISEASES OF INDIAN MEDICINAL PLANTS-I BY

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An account of four diseases of opium poppy (*Papaver somniferum* L.), namely Downy mildew caused by *Peronospora arborescens* (Berk.) de Bary, powdery mildew caused by *Erysiphe polygoni* DC, Root rot by *Macrophomina phaseolina* (Maubl) Ashby and bacterial soft rot by *Bacterium papaveris* (Ayyar) Burgirty is given. Of the diseases downy mildew is the most serious.

INTRODUCTION

In recent times, medicinal plants have assumed importance. They are now cultivated on a commercial scale. Diseases have been reported on a large number of medicinal plants. These have often been responsible for causing loss in yield and quality. It is attempted to give a concise account of different diseases on a number of medicinal plants.

POPPY, OPIUM

Botanical name : *Papaver somniferum* L.

Family : Papaveraceae

It is cultivated in warm and temperature regions of Asia, Europe and North Africa. It is cultivated also in India.

Plant is an erect annual, glaucous green, glabrous, scarcely branched, about 0.6 m high or more.

Fruits and latex are used for several medicinal preparations and narcotics (Opium, morphic). Poppy seeds are used as food and as a source of fatty oil. Poppy seed oil is widely used for cutinary purposes. Opium poppy is cultivated for the production of opium. At present, opium poppy is cultivated mainly in India, Turkey and U.S.S.R. It is also grown to a small extent in Yugoslavia, Bulgaria, Afganistan, Pakistan and Japan. The cultivation of opium poppy in India is controlled by the Government and is mainly now confined to Uttar Pradesh, Madhya Pradesh and Rajasthan. The importance of opium poppy in Indian agriculture has been reduced to considerable extent to its limited and licenced cultivation and very restricted use

of the drug, the scale of which is controlled by the Government. Naturally investigations into the disease of this crop plant have suffered and practically no work has been done for sometime past.

Downy mildew

Peronospora arborescens (Berk.) de Bary

Downy mildew of opium poppy has been reported in a mild form throughout the opium growing tracts of Uttar Pradesh. The disease has occasionally been observed to appear in localized areas in an epiphytotic form causing serious loss.

This disease is known as blight for a long time in Government records wherein it has been stated that this disease along with *Rhizoctonia* root rot was found responsible for loss of 20-30 per cent of the yield, amounting to £ 1,250,000 to the grower at the market price in 19th century (Cunningham, 1897). The disease has also been reported to cause extensive loss in other countries (Darpoux, 1945; Proshkarka, 1928; Yossifovitch, 1928; Skoric, 1930; Proshkina - Kobezskaya, 1928; Mosez, 1938; Petrak and Esfandiari, 1941; Lindquist, 1939; Cotton, 1929).

The fungus, besides infecting opium poppy, attacks other garden forms of *Papaver* and *Argemone mexicana*, a common weed. The disease has also been reported attacking various species of *Meconopsis* (Alcock, 1933).

In India the disease has been observed to appear in the field during middle of February, when the crop is full grown. It occasionally appears in November-December (Butler, 1918). In Yugoslavia it attacks seedlings also, which may be killed outright (Yossifovitch, 1929).

SYMPTOMS

The disease symptom is confined to the leaves which are covered with pale brown spots near tips. Infection may spread to other areas, eventually covering the entire leaf surface and the stem in some cases. The infected areas dry up, wither and become papery and brittle. In cases of severe attack, the entire leaf may be killed. A very fine grey-violet downy fungal growth formed by the conidial stage of the pathogen scarcely, visible to the naked eye is present on the under surface. Infection may also appear on the inflorescence.

THE CAUSAL ORGANISM

The mycelium is intercellular, probing haustoria into cells and eventually killing them. The mycelium may also develop immediately below the epidermal cells, into which it sends haustoria (Yossifovitch, 1928), but Ikata and Yamauti (1941) observed them to be saccate in the early stage but dividing into short branches at maturity,

while Yossifovitch (1928) stated that they are filiform and slender. In young leaves, hyphae pass round the vascular bundles but in older leaves their progress is arrested by veins. When the stem is attacked, the mycelium is chiefly located in the cortical cells but may penetrate the stele and reach the pith. Hyphae collect in the spaces beneath the stomata and send conidiophores singly or in groups of 5-6 through the stomata. Conidiophores are robust, erect, very long, may be upto 1 mm in length and 10-12 μm in breadth. Conidiophores are 7-10 times dichotomously branched and the ultimate branches are fine, curved short, diverging almost at right angles, pointed at the tip and bearing a single round to oval conidium at each tip. Conidia are hyaline, or light violet and measure 20-25 μm X 18-10 μm . (Butler, 1918). Yossifovitch (1928) reported that two forms of conidia are produced an oval form, measuring 13.0-26.0 μm X 11.0-19.6 μm (average 18.7 μm X 16.3 μm) and an elliptical form, measuring 16.9- 29.0 μm X 14.0- 21.0 μm (average 23.3 μm X 16.3 μm). Yossifovitch further stated that on leaves containing oospores, simple unbranched conidiophores, each bearing a terminal elliptical conidium of normal size and shape, can be observed. These conidiophores may remain very short and bear a conidium at the time of their emergence or may elongate upto 60 μm and then produce a conidium at the tip. Conidia germinate by the production of germ tube from the end or side. The tip of the germ tube broadens out at the contact of solid surface and an infection peg forms. The optimum temperature for germination is 17°C-18°C, minimum is 4 C-7¼C and the maximum 25¼C- 26 C. The oospores are produced in abundance inside the tissue of the withered spots. They are round, thick walled surrounded by an irregularly thickened reddish brown wall, 4-5 μm in thickness in places. The oospores, which are yellowish measure 22-23 μm and lie one inside each oogonium which has an average diameter of 33 μm .

PERPETUATION AND SPREAD

The disease is carried over from one season to another by means of oospores formed. It is not a seed borne disease in opium poppy but fragments of capsules carrying the infection may prove to be a dangerous source of infection. In *Mecopopsis* the disease is carried by the seed (Alcock, 1933).

CONTROL MEASURE

All diseased plants and plant debris should be carefully and thoroughly collected from the field and should be destroyed by fire to minimize the source of primary inoculum. Butler (1918) recommended Bordeaux mixture spraying, but Yossifovitch (1929) reported that copper spraying has proved failure in Yugoslavia because the spray mixture does not adhere to the leaves even with the addition of the spreader and cassain. Alavi (1975) recommended 3 sprays of bisdithane at 0.15 per cent or benlate to control the disease in Iran. A crop rotation of 4-5 years with 1 year fallow and cucurbits, wheat, lucerne or clover is recommended (Alavi, 1975). Turk-

hede *et al* (1982) based on the results of fungicidal use for control of the disease state that Ridomil (metalaxyl) (etrudiazole) tested against *Perenospora arborescences* on *Papaver somniferum*, as seed dressing and 3 sprays, significantly improved opium and seed yields.

Cultivated races of opium poppy have been found to vary in this resistance to the attack of downy mildew. Cultivation of selected immune varieties may afford the best means of control.

Powdery mildew

Erysiphe polygoni DC.

Powdery mildew of opium poppy has been found to occur in Rajasthan in a severe form (Kothari, 1968 ; Kothari and Prasad, 1972). Poppy cultivation has been reported to suffer from heavy loss due to this disease.

SYMPTOMS

Powdery mildew is observed in the fields 14-16 weeks after planting i.e. usually at and immediately after flowering stage. Late sown crop (after 15th November) suffers very much. Crop sown before 15th October almost escapes the disease. First appearance of disease is in late February or early March. The base of the stem is attacked first where small, circular patches consisting of radially arranged mycelium appear. These gradually enlarge and sporulation starts soon. Several new colonies continue to appear covering large part of the stem. 7-10 days after the appearance of disease, blackening develops to its maximum $\frac{1}{2}$ - $\frac{3}{4}$ portion of stem appears black interspersed with green patches. The mildew appears on the leaves in the form of white angular patches of fungal growth on the lower sides of the leaves. The corresponding upper surface of patches develops chlorosis followed by necrosis. Growth of mildew on leaves is luxuriant in shade. The buds on such branches remain undeveloped and wither. Powdery mildew is not found on peduncle, floral parts and capsule.

PERPETUATION AND SPREAD

It survives on the cultivated poppy in hills during summer and appears on the plains during winter. Survival through cleistothecia is not known. Secondary spread is by conidia carried by air.

CONTROL MEASURES :

The powdery mildew of opium poppy caused by *E. polygoni* can be effectively and economically controlled by only one application of any wettable sulphur using 0.5 per cent concentration at the time of first appearance of the disease in the field or when crop has reached the age of 80 days (Kothari and Prasad, 1972).

Root rot

Macrophomina phaseolina (Maubl.) Ashby (= *Rhizoctonia bataticola* (Taub.) Butler).

Root rot of *Papaver somniferum* caused by *Macrophomina phaseolina* along with downy mildew was found to be responsible for heavy losses recorded (Butler, 1918). It has been found to be prevalent in some parts of Bihar and Uttar Pradesh, particularly in the impoverished and badly drained fields. Despande *et al* (1969) reported this disease from Rajasthan.

The affected plants begin to wither and dry up from the collar region, show blackening and cracking and the roots are disorganized. The attacked regions show dry rot and the leaves dry up as a whole-not in patches as in the case of attack of downy mildew. On the affected tissues mycelial growth is first observed, followed by the appearance of a large number of tiny black sclerotia.

The causal organism was reported by Butler (1918) to be a black sclerotia form of *Rhizoctonia* attacking cowpea, cotton, groundnut and jute. The organism has later been identified as *Macrophomina phaseolina*. The fungus has a wide host range.

The hyphae when young are colourless and abundantly branched, branches arising almost at right angles from the parent hyphae and then bending rapidly to be parallel to it. The base is usually constricted and a septum is formed at a short distance from this point. Hyphae, 8-9 μ m in diameter, are septate at long intervals, the older being brown. At a later stage brown hyphae consist of short barrel-shaped cells. During the formation of sclerotium, a mass of parenchymatous cells is formed from a single hyphae by constant division. These cells are eventually transformed into a mature sclerotium, which is smooth, black, and about 100-150 μ m in diameter.

Macrophomina root rot can be controlled with good cultivation of the crop and by paying proper attention to drainage and manuring. The susceptible hosts should not be included in rotation (Butler, 1918).

Bacterial Soft Rot

Bacterium papaveris (Ayyar) Burgwitz (= *Erwinia papaveris* (Ayyar) Magrou)

Butler (1918) reported that poppy sometimes is attacked by a disease of bacterial origin. A similar disease was observed on *Papaver shoeys* by Ram Ayyar (1927) and a detailed investigation was made. The causal organism was named *Bacillus papaveris* Ram Ayyar. This organism was later renamed as *Bacterium papaveris* (Ayyar) Burgwitz. It was also further renamed later as *Erwinia papaveris* (Ayyar) Magrou (Diet. Bact. Path. Paris, p. 214, 1937). Atanasoff *et al.* (1932) from Bulgaria reported the occurrence of *Bacillus* (*Erwinia*) *papaveris* Christoff, which

is definitely the same as the previous one (Elliot, 1951). The organism closely resembles *Bacterium aroideae* (Townsend) Stapp or *Erwinia caratovora* (Townsend Holland, with which it is considered synonymous by Elliot (1951). Ram Ayyar (1927) also considered the organism to be closely allied to *Bacterium aroidae*, but differing only in chromogenic characters.

This disease is characterized by external blackening and internal disintegration, accompanied by the discolouration of the midrib of the leaves. Butler (1918) reported that the disease commences at the apex and extends downward and the whole plant is eventually turned into a slimy mass. The organism is a short actively motile rod, 0.5-2.5 μm X 0.5 μm , with rounded ends, strictly aerobic, Gram negative, non-acid-fast, non-sporulating and non-capsulate, with 2-8 peritrichous flagella. It grows well in most of the bacteriological media and the optimum temperature for growth is about 30°C and thermal death point lies between 50°C and 60°C. Broth culture is clouded. Colonies on solid medium are smooth, hyaline to apalescent, slightly raised round, with entire or slightly wavy margins. It liquefies gelatin, does not hydrolyse starch, coagulates milk but does not peptonize it and does not produce indole. It forms acid in peptone broth containing glucose, lactose and glycerol.

The exact mode of perennation of the disease in India is not known. The organism is capable of living in culture media for over 6 months. Atanosoff *et al.* (1932) reported that the organism can retain its viability on poppy seeds for over 20 months in which case the disease can be easily transmitted through seeds. If the organism is the same as *Bacterium aroidae* or *Erwinia aridae*, it has a very wide host range and the disease can easily pass from one season to another through numerous hosts. No control measure is known.

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