

DOWNY MILDEW OF SUNFLOWER
***PLASMOPARA HELIANTHI* NOVOT.**

=*P. halstedii* (Farlow) Berl. et Detoni

=*Peronospora halstedii* Farlow

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Summary

History, hosts and distribution

A comprehensive study of literature is carried out under this topic in Farsi (Persian), regarding the complex of *P. halstedii* (Farlow) Berl. et De Toni on different hosts among species of *Compositae* and *P. helianthi* Novot. on *Helianthus annuus* each one separately, as already stated in different countries.

The first record of the occurrence of the Downy mildew of sunflower in Iran is from LEPPIK (1962). Then the disease is reported by MINASSIAN (1968) as being observed in 1967 at Khoy of Azarbayejan province and by VIENNOT - BOURGIN *et al* (1969). The disease is also seen in 1969 by SCHARIF (writer) in Rezayeh of Azarbayejan.

As surveyed by the writer in the summer of 1970, the downy mildew of sunflower is spread in almost all regions of East Azarbayejan (Ahar, Meshkinshahr, Marand, Makoo) and some regions of West Azarbayejan (Khoy, Rezayeh). The disease was not observed in eastern and southern parts of the Lake of Rezayeh, namely: Malek-Kandi, Miandoab, Mahabad, Naghadeh and Bookan.

The disease was not observed, neither in the Caspian sea area where the climatic conditions seemed to be completely favorable for its development, nor in other parts of the country. Until 1971, when for the first time it was found in a field of Dasht-Naz of Mazandaran of which the seed was from Rumania, and Aliabad and Fazelabad of Gorgan and Roodbar of Guilan.

Loss

As stated by NISHIMURA (1922) 70% of sunflower plants were attacked in infected experimental plots in Columbia, while in check plots the disease was none.

HENRY and GILBERT (1924) by their experiments and observations in Minnesota spoke of

the disease as a very dangerous one. In Saratov No. 17 variety of sunflower they observed 90% of diseased plants.

As mentioned by YOUNG *et al* (1929) the Russian Mammoth variety of sunflower was severely attacked by downy mildew in 1927 at Bozeman of Montana, where 6% of plants were infected and in one row up to 26% of plants were diseased.

SACKSTON (CONNERS, 1954) reported 60% infection by downy mildew in a field of sunflower (in some parts of the field up to 95%) at Manitoba of Canada.

YAGODKINA (1955-1959) stated up to 76% infection of sunflower plants in some fields of Krasnodar (Russia).

LOUVET & KERMOAL (1966) observed 70-80% of diseased plants in plots where sunflower was grown for two years successively.

In Azarbayejan of Iran, as surveyed by SCHARIF (writer) in 1970, 5 to 20% of sunflower plants in some fields of infected areas were diseased.

Symptoms

The fungus is usually transmitted from infected soil or seed to the under ground parts of the plant and develops systemically in growing plant.

On seedlings the symptoms of the disease appear as mosaic flecks (a mixture of dark and pale green) on cotyledons and first leaves. In a severe case the plant dies after one or two weeks.

If the disease is not severe at the beginning of growth, the plant continue to grow for a shorter or longer time, but it remains more or less shorter (1/3 to 1/5 and sometimes to 1/10) than a normal plant. Such a stunted plant bears a thicker stem and more or less shorter internodes, so that the leaves remain very close to each other and smaller in size than normal. The flower heads (capitula) on such a thickened and stunted stem consist usually of only one capitulum, which stand upright at the top of the stem, but sometimes smaller capitula may form under the top one and very close to it.

As the disease develops systemically in more or less grown plants, leaves of such plants show mosaic symptoms having the source from diseased stem and developing through petiole along mid-rib and secondary veins. Affected leaf veins are lighter in colour and sometimes thicker than healthy and normal ones. In young leaves, when discoloration of the mid-rib is present, sometimes crinkling of the surface of leaf may also appear. Under wet conditions conidia and conidiophores (sporangia and sporangiophores) of the fungus appear underneath the leaf on affected discoloured parts as a more or less white velvety growth. Under very wet conditions they may also be produced on the upper surface of the leaf.

The inside tissue of the diseased stem show a darker colour than normal. The roots also lose their white normal colour turning somewhat to dark and become fragile.

As stated by YAGODKINA (1958), downy mildew of sunflower enter the plant only by roots and when old plants are attacked, they do not show any symptom, but they may be a source of infection of soil and seeds.

According to NISHIMURA (1922), 'diseased plants produce, only a few of secondary roots.

Microscopic characteristics

Under this topic in Persian text (Farsi) are given some of results of observations and investigations of some scientists of other countries on different features of the microscopy of the fungus.

As measured by the writer from the diseased samples collected in Azarbayejan of Iran, conidiophores are 175 to 445 microns long (mean length 330) and conidia 16-23 (18.61) $\times$ 18-31 (23.46) microns.

Oospores of the fungus are also observed in samples collected in July 1970 in Azarbayejan.

Biology

As stated by PANCHENKO (1965) the optimum temperature for production of conidia of *P. helianthi* is 16-18 C. At these temperatures and saturated humidity it takes 12-14 hours for their appearance.

As examined by NOVOTEL'NOVA (1960) the optimum temperature for germination of conidia is 16-18, the minimum 5 and the maximum 28C. They germinate mostly between 9-22C. Under zero, temperatures - 12 to - 15 C. cause the death of spores and mycelium (Polyakov, 1961).

According to GOOSSEN (1964) at low temperatures conidia last for a few months. Moreover, in the soil where diseased seedlings are grown, the fungus remains pathogen for a few months.

As studied by GOOSSEN & SACKSTON (1968) conidia on leaves stored at - 20 C. germinated 75% after 3 weeks, 10% after 14 weeks and none after 24 weeks. In sterilized soil sporangia (conidia) lasted only for 7 days.

The fungus enters the plant through under ground parts (roots, hypocotyl) and develops systemically in the whole plant. So, YOUNG & MORIS (1927) could not infect artificially the sunflower plant through upper side of leaves without wound.

According to NOVIKOVA (1958) the period of sensitivity of sunflower plant to secondary infections by the downy mildew fungus is very short, starting from 4-5 pairs of leaves to the production of next pair.

Transmission of the disease from year to year is usually by oospores which remain in infected debris of the plant. However, infection can take place by the soil infected with viable conidia of the fungus (Nishimura, 1922).

According to NOVOTEL'NOVA (1963), the mycelium of the fungus accumulates in the growing points of the plant, so it may reach and infect the inflorescence and seeds. However as stated by this worker the seed may be a source of infection.

As studied by GOOSSEN & SACKSTON (1964) infection of sunflower seedlings occurred severely at 18-24 C. Moreover, in an intense light the growth of hypocotyl was retarded, so the infection occurred also more frequently. The infection was also severe when these workers (1968) used suspension of conidia as inoculum to infect seeds.

Race

Downy mildew of sunflower was first identified as *Plasmopara halstedii*, a name common for

downy mildew on different hosts belonging to family of *Compositae* (Saccardo, 1888). Then SAVULESCU (1941) named *P. megasperma* Savul. on *Scorzonera humilis* and *P. spaerosperma* Savul. on *Tragopogon dubius*.

Later on, NOVOTEL'NOVA (1962), distinguished 10 species and 12 forms of *Plasmopara* on different hosts from *Compositae*, and thus separated the downy mildew of the Genus *Helianthus* under the name of *P. helianthi* from so named *P. halstedii* complex already known for different species of the family. Moreover, this worker divided *P. helianthi* in three forms, namely: *P.h. f. helianthi* on *Helianthus annuus* and, *P.h. f. perennis* and *P.h. f. patens* on perennial plants of the genus *Helianthus*.

Taking on account the above mentioned evolution on the knowledge of the fungus on *Helianthus annuus*, the problem of the existence of different races in *P. helianthi f. helianthi* is not still sure; so that, if some workers like YAGODKINA (1958) and LEPIIK (1966) have already spoken of the presence of different races of the fungus, they may have been referring more to the complex of *P. halstedii* on different species than to *P. helianthi f. helianthi* restricted to *Helianthus annuus*.

Control

As resulted from investigations of many workers downy mildew of sunflower infect the plant usually by the way of under ground parts of the young plant (roots and hypocotyl) and the period of sensitivity of the plant is very short. So the contaminated soil or seeds are the most important sources of infection, and the attempts for the control of the disease must involve either removal of infection from infected soil and seeds and using healthy soil and seeds, or cultivation of resistant varieties.

In Persian text under the topic of "control" the following sub-topics are discussed reviewing the works of investigators in other countries:

- 1- Sowing healthy seeds.
- 2- Seed disinfection.
- 3- Rotation or fallow.
- 4- Destruction of remains of previous infected crop.
- 5- Destruction of possible spontaneous hosts other than *Helianthus annuus*.
- 6- Soil disinfection
- 7- Cultivation of resistant varieties.

Research is started at Plant Pests & Diseases Research Institute at Evin, Tehran, on different aspects of the disease, especially resistant varieties.

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