LATEST SUNFLOWER DISEASES RESEARCH PROGRESS AND MANAGEMENT

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Sunflower diseases have been and remained a major limiting factor in successful sunflower production in the world. From the historical point of view, in several last years, new disease agents did not emerge, exept several exceptions. However, ''virulent pathotypes'', usually called pathogenic races occured in some diseases. Diseases are far the most important factor in yield reduction, although they emerge in different intensity per years and growing regions.

Sunflower diseases

Diseases caused by Fungi and Oomycetes	68
Diseases caused by Bacteria	7
Diseases caused by Phytoplasmas	2
Diseases caused by Parasitic Nematodes	19
Diseases caused by Viruses	8
Diseases caused by Parasitic Plants	
•Dodder	3
•Broomrape	5
Total	112

Plasmopara halstedii (Farlow) Berlese and Toni
Downy Mildew

The oldest and sometimes the most devastating disease is downy mildew of sunflower for which in 80s of the last century only two races were known. Since then the exact ˝invasion˝ of races has occurred, and nowadays in the world over 40 races are recorded.

Distribution of Races

Downy mildew is a particulary destructive disease in the north-central United States (21 new races) and in south-central Canada (18 new races), beacuse this area is the center of origin for *Helianthus spp*.

In Argentina, downy mildew is an economic problem, the pathogen races 300, 330, 710, 730 and 770 have remained relatively stable for decades.

Distribution of Races

Europe – 13 new races in last decade and 14 previously established

Czech Republic – 7 new races (700, 704, 710, 730, 770, 705, 715)

Hungary – 7 new races (700, 730, 704, 714)

Serbia – 3 new races (100, 700, 730)

Romania – 7 new races

Bulgaria – 5 new races

France – 13 new races

Italy – 3 new races

Germany – 9 new races

Russia – 7 new races

Sunflower differential lines with corresponding resistance genes and virulence phenotype of new races 705 *71* and 715 *71* (+ = virulent; – = avirulent) (Sedlarova et al. 2016)

Set of differentials	Number	Virulence value	Sunflower line	Known *Pl* (*R* genes)	Race/virulence profile	
					705 *71*	715 *71*
1	D1	1	Ha-304	-	+	+
	D2	2	2 RHA-265	Pl_1	+	+
	D3	4	RHA-274	Pl_2/Pl_{21}	+	+
2	D4	1	PMI-3	Pl_{PMI3}	-	+
	D5	2	PM-17	*Pl5*	-	-
	D6	4	803-1	*Pl5+*	-	-
3	D7	1	HA-R4	Pl_{15}[1]/Pl_{16}[2]	+	+
	D8	2	QHP-2	*?*	-	-
	D9	4	Ha-335	Pl_6	+	+
4	D10	1	Y7Q	Pl_6-	+	+
	D11	2	PSC8	Pl_2	+	+
	D12	4	XA	Pl_4	+	+
5	D13	1	PSS2RM	Pl_6/Pl_{21}	+	+
	D14	2	VAQ	Pl_5	-	-
	D15	4	RHA-419	Pl_{ARG}	-	-

[1]Gascuel *et al. (2014)*; [2]*Liu et al. (2012)*

Distribution of Races

Asia – 2 races in India and China, both considered low virulence

Africa – Maroco (4 races)
– South Africa (10 races – 330, 710, 730)

Australia – No Downy mildew

New Zeland – No Downy mildew

FIVE TRIPLET CODE

9 standard lines (differentials)

During 2015, 13 additional lines were found:

- **6 lines** – were reported by French authors
- **1 line – established** in Argentina
- **6 lines – identified** in U.S.

Downy mildew can be both seedborne and seed transmitted disease. Sistemically infected field plants are not a major source of infested seeds.

Seed treatment by fungicides and use of resistant genotypes is widely accepted measure against this oomycete. The problem in this case is wide genetic variability of pathogens. It seems that winning combination are resistant hybrids and fungicide seed treatment. This measure has the best perspective, and in contemporary conditions its duration should be the longest until discovery of some new indicators.

Genetic resistance is most effective and important crop management strategy to control the disease. The situation with confectionary sunflower is not so encouraging because no commercial hybrids are yet available with for downy mildew resistance. Recent studies made in U.S. provide findings of some lines for further selection work that is expected to be finished by the beginning of 2017.

Phoma macdonaldi Boerema
Black Spot

Phoma macdonaldi is present in almost all sunflower growing regions, but intensity of infection and impact on yield remained on the level from previous years. *Phoma* black spot has been the most widely observed disease on sunflower across the all U.S. sunflower production area of the central Great Plains. And this was the case until the first occurrence of the disease in 1980.


The reason for damages is prescribed to the source of infection which is in America mainly on the stem surface and it does not penetrate deeper into the vascular tissues. The highest damages occurred in cases when *Phoma* is transmitted by seed or when black spots are on the surface level. Severely infected plants are weakened and may produce smaller heads, resulting with reduced seed yield and oil percentage.

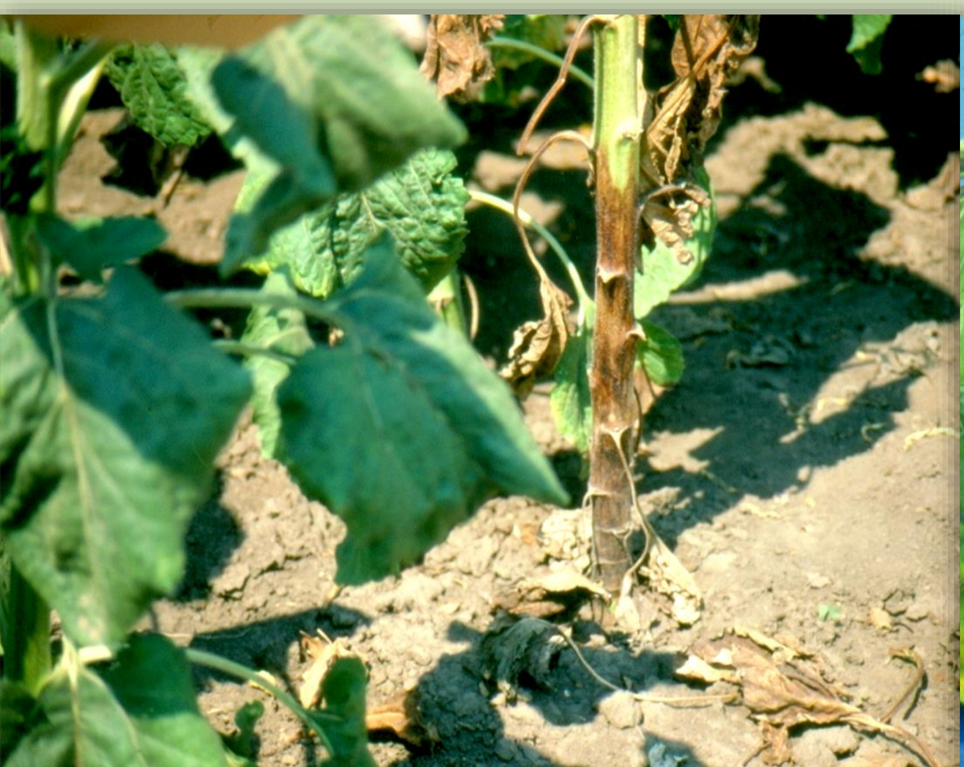
This fungi is very interesting because it has not been established in the perfect stadium in new regions expect in previously determined localities in Argentina, Former Yugoslavia and the U.S. New in systematic is that now this fungus is named *Plenodomus lindquisti*.

Narrow crop rotation and reduced tillage are highlighted as important factors in spread of the disease in southwest parts of France. The occurrence of black stem is in positive correlation with the increase in nitrogen fertilization. Significant and efficient way for control of the disease is increase of resistance toward *Phoma macdonaldi*.

Hybrid resistance is efficient, environment friendly and fairly inexpensive for sunflower growers. Maybe control of *Phomopsis complex* at the same time controls *Phoma,* also reducing the damage caused by this agent.

Phomopsis (*Diaporthe/Phomopsis spp. complex*)
Brown Stem Canker

Brown Stem Canker is one of the most yield-limiting diseases worldwide on oilseed sunflower. This disease became a limiting factor for sunflower production because it not only causes oil seed yield losses, but also causes sunflower oil deterioration.



A total of ten new *Diaporthe* species have been added as sunflower pathogens, including *D. Gulya* Shivas, Thompson and Young*, D. Kongii* Shivas, Thompson and Young*, D. Kochmanii* Shivas, Thompson and Young*, D. Masirevicii* Shivas, Thompson and Tan*, D. Sackstonii* Shivas, Thompson and Tan. Of these, *D. gulyae* is the most aggressive, comparable with *D. helianthi*, and the former occurs in Australia, Canada and in the U.S.

Researches accomplished in Australia and some other countries clearly showed that weeds and their remainings after vegetation are actually brown bridge for *Diaporthe* species that can be harbor for propagation of pathogenic, saprobic or endophytic.

Complete burial of infected plant residues, at least 5 cm deep, is most thoroughly accomplished by plowing and not disking. This ˝strategic tillage˝ need only be done after an infected crop. In Europe it has been found that stalks need to be buried deeper than 15 cm to prevent perithecial maturation.

Elimination of weeds and volunteer sunflowers will reduce inoculums. However, due to lack of detailed information on the weed host range of *Phomopsis* species, precaution in weed control is necessary for the purpose of limiting the disease build-up on possible weed hosts. Damaging *D. gulyae* has been isolated from multiple weed hosts in Australia including live Noogoora Burr (*Xanthium pungens*), Bathurst Burr (*X. spinosum*), Saffron Thistle (*Carthamus lanatus*) and Common or Sow Thistle (*Sonchus oleraceus*).

Systemic strobilurin compounds are likely to be the most effective for control, while combinations for prevention and curative fungicides produce better control.



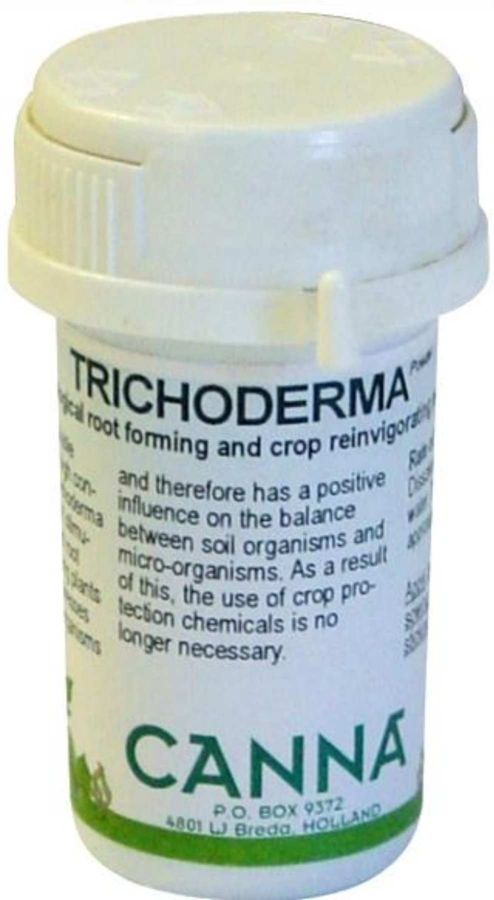
Sclerotinia spp.
Stalk Rot, Head Rot, Wilt and White

S. sclerotiorum is global in distribution on various host's climates and is found in every sunflower producing country. Most frequently it can be found in temperate climates.

Sclerotinia minor is more frequent in hot, dry climates, and is observed on sunflowers in Argentina, Australia, the Indian subcontinent and EU countries bordering the Mediterranean and Black seas. In the U.S. *S. minor* is reported on sunflower only in California and Texas, and is one-six as prevalent as *S. Sclerotiorum*.

Sclerotinia-incited stem and head rots are the leading cause of yield losses to sunflower worldwide. Their impact is not only upon the existing crop, but the contamination of soil with long-lived *Sclerotia*, and their wide host range.

Many commercial biocontrol products, based on fungi such as *Coniothyrium, Gliocladium*, and *Trichoderma,* and bacteria such as *Bacillus subtilis*, will fasten degradation of *Sclerotinia* and shorten the interval between planting another susceptible crop.



Biofumigation by planting *Brassica* cover crops, and tilling them under will release isothiocyanates, which are toxic to a range of fungi.

In certain sunflower hybrids, some progress has been made in developing partial (incomplete) resistance or tolerance to *S. sclerotiorum*. There are no hybrids available with complete resistance to either of the two *Sclerotinia* spp.

Puccinia helianthi Schwein.
Rust

Sunflower rust is found worldwide on oilseed, confectionary and wild sunflowers (*Helianthus*).

North America – races **300, 304** and **777** (predominant)

Argentina – 6 new races

China –15 new races **300, 304, 310, 500, 700** (during 2013 and 2014)

Iran – races **300, 302**

Turkey – races **100, 300**

Mozambique – races **314, 315**

Set of nine international differentials were used.

Wild sunflowers can be ˝rust reservoirs˝ and provide spores to infect neighboring fields of cultivated sunflower. Presence of early spore stages on wild sunflower, allows more infection cycles.

Removal of any wild sunflower in the vicinity will minimize the production of inoculum. In the future, the problem of rust would probably be greater due to the growth of confectionary sunflower, more susceptible to rust agents and higher number of races.

Fungicides are main option for rust control. Many of the most contemporary systemic fungicides are efficient against rust. Timing of fungicide applications has more impact than the type of fungicide used. Products Tebuconazole, Pyraclostrobin and Azoxystrobin, will reduce rust. Fungicide application is most likely economical when average disease severity reaches 1 % on the upper four, fully expanded leaves prior to during bloom. It has not been proven that later applications have positive impact to yield. High clearance tractors could be used in control of many diseases that can be combined with rust control.

Alternaria spp.
Leaf Spot and Blight

Leaf Spot and Blight is one of the major defoliating pathogens in warm, humid climates. There are no reports on the occurrence of new species of *Alternaria* genus. It means that damages and the intensity of the phenomena are at level of preceding years, and previously published papers.

Removal of wild and volunteer sunflowers, removal or incorporation in the soil of previous sunflower residues will all reduce disease.

Most growers rely upon multiple applications of fungicides containing chlorothalonil, iprodione, porcymidone, or vinclozolin. In the world, protection is carried out according to need in selection material and in cases of extremely convenient weather conditions for disease occurrence.

Seedborne Diseases

Puccinia helianthi can be carried on the seed surface.

Plasmopara halstedii can be both seedborne and seed transmitted.

Sclerotinia head, midsteam and basal stalk rot (*Sclerotinia sclerotiorum*), Verticiillium wilt (*Verticillium dahliae*) and Charcol rot (*Macrophomina phaseolina*) are also seedborne diseases. Similarly is with southern blight (Sclerotium rolfsii).

Seeds of *Orobanche spp.* can be passively transported with the seed.

Alternaria leaf and steam spot (*Alternaria helitanthi*) can be seedborne.

Phoma macdonaldii and *Phomopsis (Diaporthe) complex* have been found on sunflower seeds as seedborne.

Pseudomonas syringae* pv. *tagetis* is known to be seedborne and seedtransmitted bacterial disease of sunflower. Same situation is with the spot pathogens *P. syringae* pv. *helianthi*, *P. syringae* pv. *aptata* and *P. cichorii.

Sunflower mosaic virus is suspected of being seed transmitted, as is *Tobacco necrosis virus.*

Due to employed tillage practices, i.e. no tillage or minimum tillage, many parasites remain on the surface as dry - desiccated or in infected plant residues. They are truly brown bridges for many sunflower parasites. This primarily refers to Argentina, U.S., part of France, Australia and many other countries. Increased problems in sunflower arise just in such situations.

Deep tillage and incorporation of plant residues into deeper layers, eliminates infection pressure of many parasites. In this process it is most important for *Diaporthe complex*, *Scletotinia*, *Phoma*, *Plasmopara* and some others.

Crop rotation as a system of disease control that does not have such significance if no tillage technology is applied.

Weeds should be controlled because they are reservoirs for many disease agents including viruses, and therefore they are to be eliminated from sunflower crops. Wild sunflower plants should be added to this, for wild plants are in fact weedy plants for all cultivated crops, and should be eliminated and destroyed as they often serve parasites for crossing over and as one kind of a green bridge.

Use of tractors and sprayers with high clearance for other agricultural cultures enables their application for treatment of sunflower crops against diseases. This is a way to obtain particularly high yields, especially in confectionary sunflower type that has a higher price and can serve as a place for propagation of certain parasites because it is generally less resistant to many of them.

Thank you for your attention!