THE EVOLUTION OF SOME PATHOGENS AND BROOMRAPE PARASITE ATTACK AND VIRULENCE, IN SUNFLOWER CROP, IN DOBROGEA AREA, ROMANIA

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Abstract

Sunflower diseases represent one of the most serious constraints in sunflower crop in Romania. Dobrogea region has around 24% of the area cultivated with sunflower in Romania. The pathogens attack is frequently severe and yield losses can reach up to 50 – 70 %. In the last years, climate change has an influence on the development of the pathogens, also on the host/pathogens interaction. Some changes occur between pathogenic races, some pathogens increase their attack, according with their thermal preferences Our studies have demonstrated that some of the most important pathogens in sunflower have changed their behavior in different climatic conditions. Some pathogens (*Macrophomina phaseolina, Puccinia helianthi*) which in the past did not attack too much this crop, in Romania, are present in some cultivated areas with sunflower, in Dobrogea, in the last three years. Also, the pathogen *Plasmopara halstedi*i has developed more virulent races, during the last period. The parasite broomrape (*Orobanche cumana* Wallr.) has also developed new and more virulent races, comparing with those present four years ago, especially in Constanta area.

Key words: sunflower, pathogens attack, races evolution, climate change

The climatic and edaphic conditions of Dobrogea regions of Romania is favorable for the growth and development such valuable oilseed crop as annual sunflower *Helianthus annuus* L. Growing annual sunflower on this region, heavily depends on introduction into production of varieties and hybrids which are resistant to abiotic and biotic factors (Jinga V. *et al*, 2022; Manole D. *et al*, 2022). There is supposed, harmful species imported with seed material can bring to agrocenosis new pathogens of aggressive races that in this ecological habitats can cause divesting epiphytotic and lead to significant loss of sunflower crop. Today there is involved in the production large quantities of sunflower seed materials of varieties and hybrids (Lysenko E.V., 2010). On the other hand, and from the point of view of pathology, climate change means adaptation to new conditions. Host plant and pathogen are affected by the environment which, under global climate change conditions, is responsible for shifts. Some of these shifts can affect the host, such as new cultivation practices, the use of new crop genotypes, or the emergence of new areas where particular crops can be grown. Among the factors directly related to plant pathogens we can mention more aggressive strains that, in some cases, can result in new races of pathogen populations, altered incidences of diseases (either increased or decreased) and even the evolution of cryptic and/or latent pathogens (Molinero-Ruiz L., 2019).

The fast adaptation to different growing conditions of a fungus *Macrophomina phaseolina*, led to its becoming one of the sunflower (*Helianthus annuus* L.) disease causal agents in regions with a temperate climate (Siddique S. *et al*, 2020; Cuk N. *et al*, 2022). The most appropriate control measure for this fungus is the utilization of resistance sources. To achieve this, there are

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necessary screening method, in addition to a characterized pathogen population, in order to accelerate breeding program (Talapov T. *et al*, 2021). The pathogen *Plasmopara halstedii* Farl. Berl. and de Toni causes downy mildew of sunflower, which is characterised by symptoms of stunting and leaf chlorosis. The disease is mainly controlled by means of genetic resistance, but pathogen races overcoming resistance genes in sunflower hybrids are often identified (Miklic, 2022; Ban et al, 2022). New races of this disease require constant work to introduce resistance. The final aim is the development of sunflower hybrids with most durable resistance (Goncharov S., Goloschapova N., 2021). The parasitic weed *Orobanche cumana* (sunflower broomrape) is an obligatory and non-photosynthetic root parasitic plant of the sunflower (*Helianthus annuus* L.) Under favorable conditions, it infects the roots of sunflower plants and connects to the vascular tissue, thus depleting the nutrients and affecting host growth and yield (Molinero-Ruiz et al, 2015). Broomrape seeds are very small and individual plants can produce an impressive number of seeds that remain viable. For controlling the parasite, major difficulty for the breeders is the fast development of new races of this, which overcome the resistance of sunflower genotypes (Joita-Pacureanu M. *et al*, 2022).

This paper presents the results of monitoring some pathogens and broomrape parasite attack, in sunflower crop, in Dobrogea area, Romania.

MATERIAL AND METHOD

Twelve sunflower hybrid have been studied in order to have information about their behavior regarding the resistance to some pathogens, also to the parasite broomrape, in two locations and two years. These hybrids have been studied for resistance to the pathogen *Macrophomina phaseolina*, also for the parasite broomrape. It has been analyzed the number of sunflowers/plot, number of broomrapes /sunflowers, also the seed yield, in conditions of high infestation with broomrape.

The resistance to the pathogens and broomrape was evaluated in natural infection/ infestation conditions, in two locations situated in areas Constanta and Tulcea, with different virulence of downy mildew races, also with different broomrape populations. For determining the downy mildew (*Plasmopara halstedii*) and broomrape (*Orobanche cumana*) races there have been used the differential sets for pathogen and parasite races, the two sets containing the sunflower genotypes belonging to the international sets.

RESULTS AND DISCUSSIONS

The results obtained are highly influenced by the climatic conditions, also by the degree of infection/infestation with studied pathogens and parasite. The infection/infestation was influenced by the climate in the two years. In *figures 1* and *3* are presented the air temperature values in the two years, 2020 and 2021, in the two locations, where the experiments have been released. In both locations (areas) in 2020 year there have been registered higher temperatures, comparing with 2021 year.

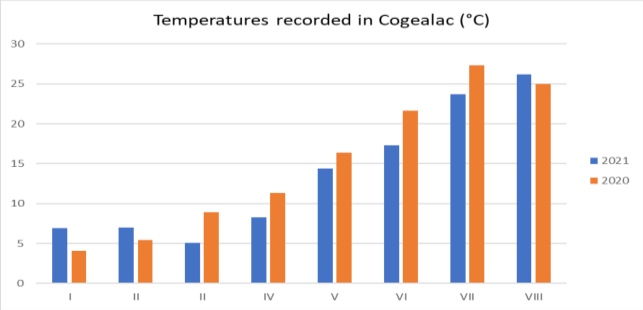

Figure 1 **Temperatures recorded in Cogealac, CT**

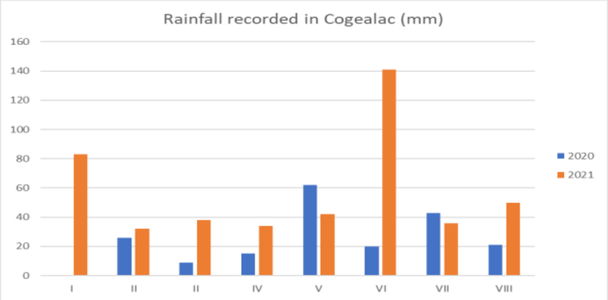

Figure 2 **Rainfall recorded in Cogealac, CT**

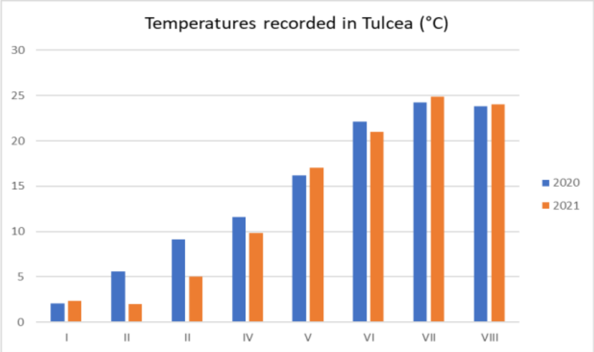

Figure 3 **Temperatures recorded in Tulcea area**

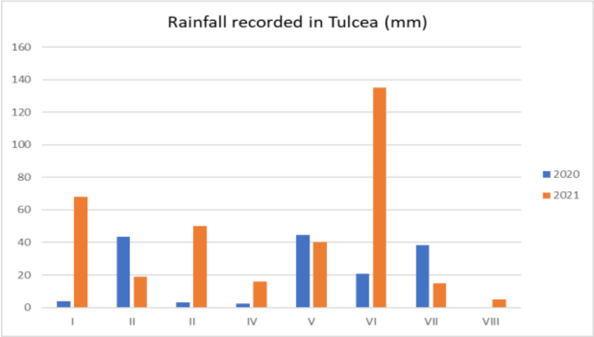

Figure 4 **Rainfall recorded in Tulcea area**

In *figures 2* and *4* are presented the values of registered rainfalls, in these two locations and two years. In both locations the rainfall values are higher in year 2021, specially in June, also in spring time, in this way being created conditions for the attack of the pathogen *Plasmopara halstedii*.

The climatic conditions were favorable for the pathogen *Macrophomina phaseolina* attack, specially in 2020 year, in both locations, also in both years, in Tulcea location (*table* 1).

Table 1

Results regarding the attack degree of *Macrophomina phaseolina* on the sunflower hybrids set, in two locations and two years

No.	Hybrid/	Attack degree (%)	Attack degree (%)	Hybrid/ Tulcea	Attack degree (%)	Attack degree (%)
	Cogealac	2020	2021		2020	2021
1	HS 2142	10.3	0.5	HS 2142	21.3	8.6
2	HS 2189	11.6	1.4	HS 2189	25.6	7.5
3	HS 2334	9.4	0.6	HS 2334	11.7	3.4
4	HS 2365	7.7	1.2	HS 2365	9.8	7.4
5	HS 2844	3.2	0.4	HS 2844	7.3	2.1
6	HS 2878	1.7	0.7	HS 2878	12.9	3
7	HS 2890	11.8	1.3	HS 2890	31.6	2.4
8	HS 3029	6.5	2.7	HS 3029	20.4	4.6
9	HS 3104	1.2	1.9	HS 3104	2.6	0.7
10	HS 3147	12.6	7.4	HS 3147	34.9	11.6
11	HS 3155	1.8	1.7	HS 3155	22	2.8
12	HS 3168	4.8	1.2	HS 3168	24.5	3.2
15	Performer	0.9	0.2	Performer	3.2	0.6
16	FD15E27	1.3	0.7	FD15E27	5.4	0.4

Unexpected favourable conditions for downy mildew development have occurred in Dobrogea region in the spring of 2021. Consequently, important outbreaks have been observed even in highly resistant hybrids. More than 24 samples of affected resistant hybrids collected in different locations in this region have been recovered and characterized by inoculation of the differentials of races, in artificial infection conditions As a result, races 314, 330, 334, 700, 710, 714, 730 and 770 have been identified (*table 2*).

Table 2

The races of the pathogen *Plasmopara halstedii*, identified in two locations, in area cultivated with sunflower, in Dobrogea region.

Pathogenic races								
Races Zones	314	330	334	700	710	714	730	770
Constanța	x	x	x	x	x	x		x
Tulcea		x	x	x	x	x	x	x

Using the differential set for the broomrape parasite races, there have been identified in the cultivated areas with sunflower, infested with broomrape, more than six races of this parasite. For the first 6 races, the resistance is clear, being determined by major dominant genes. After that, because the parasite has developed in short time new virulence, it is not clear which races are present, also which type of inheritance characterizes the resistance (*table 3*).

Table 3

Races of the broomrape parasite in sunflower crop, in Romania

Differential lines	Broomrape races						Resistance	Genes of resistance
	A	B	C	D	E	F		
AD-66	S	S	S	S	S	S	R0	-
Kruglik A-41	R	S	S	S	S	S	R1	Or_1
Jdanov 8281	R	R	S	S	S	S	R2	Or_2
Record, H-8280	R	R	R	S	S	S	R3	Or_3
S-1358, O-7586	R	R	R	R	S	S	R4	Or_4
P-1380-2	R	R	R	R	R	S	R5	Or_5
LC-1093	R	R	R	R	R	R	R6	Or_6
Different genotypes							Different types of resistance	
Different genotypes							Different types of heredity	Or 7
								Or 8

Studying a number of new sunflower hybrids, with good resistance to the new races of the broomrape parasite, we found that no one of hybrids is full resistant. In Cogealac, Constanta area there are the most virulent races of the parasite broomrape, in Romania.

Table 4

The attack degree of broomrape parasite (*Orobanche cumana)* on sunflower hybrids, experimented in conditions of Cogealac, Constanta location, in 2020

No	Hybrid	Broomrape attack (%); Seed yield(Kg/ha)			
		Sunflower plants	Broomrapes on sunflowers	Attack degree (%)	Seed yield (Kg/ha)
1	HS 2334	68	23	5.4	3142
2	HS 3104	77	36	8.9	2980
3	HS 2890	79	11	3.0	3379
4	HS 2844	81	9	2.3	3077
5	PR64LE99	76	10	2.6	3724
6	Performer	80	233	63.9	1893
DL 5%					8.4

The hybrids with good resistance have released good seed yield, due to their behavior regarding the broomrape attack (table 4 and 5). In 2020 year, the degree of broomrape attack was higher, due to climate conditions, favorable for the parasite developing.

Table 5

The attack of the broomrape parasite (*Orobanche cumana*), on the sunflower hybrids , experimented in conditions of Cogealac location, 2021 year.

No	Hybrid	Broomrape attack (%); Seed yield(Kg/ha)			
		Sunflower plants	Broomrapes on sunflowers	Attack degree (%)	Seed yield (Kg/ha)
1	HS 2334	76	11	3,2	3354
2	HS 3104	81	29	8,4	3189
3	HS 2890	84	7	1,7	3787
4	HS 2844	79	4	1,2	3695
5	PR64LE99	82	7	1,3	3863
6	Performer	78	137	45,7	2132
DL 5%					12,7

CONCLUSIONS

The pathogens attack is frequently severe in Dobrogea area, in Romania and yield losses can reach up to 50 – 70%. In the last years, climate change has an influence on the development of the pathogens, also on the host/pathogens interaction. Some changes occur between pathogenic races, some pathogens increase their attack, according with their thermal preferences. For most of sunflower pathogens, an effective management relies on genetic resistance which is, however, hindered by new pathogen populations (new races). New races of *Plasmopara halstedii* (sunflower downy mildew), have been identified in Dobrogea area, Romania. Most of them have a high virulence, since they overcome several genes for resistance. The pathogen characterization is essential for genetic resistance for different environments of sunflower production. The sunflower yield and its profitability is dependent not only on effective genetic resistance, but also on some new control options that can be included in strategies of sunflower disease management.

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