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INFLUENCE OF SOWING TIME ON THE OCCURRENCE OF ALTERNARIA LEAF SPOT, RUST AND BROOMRAPE ON SUNFLOWER

Ioan Radu[1,2*], *Lorena-Roxana Gurău*[1]

[1]Research - Development Institute for Plant Protection Bucharest, Romania
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania

*correspondence address
Research-Development Institute for Plant Protection Bucharest
8 Ion Ionescu de la Brad, PC 013813, Bucharest, Romania
E-mail: raduioan1999@gmail.com

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Abstract: The occurrence of Alternaria leaf spot (*Alternaria helianthi*), rust (*Puccinia helianthi*) and broomrape (*Orobanche cumana*) on six sunflower hybrids were assessed to notice the effect of sowing time (ST). ST was set taking into account the Celsius degrees at the soil depth of 7 cm: ST1 at 5°C, ST2 at 7°C and ST3 at 9°C. The research was performed in the field experiments in Tulcea county in 2021 under rainfed conditions. Observations on the attack intensity (% of the leaves area) have done after the flowering period for *A. helianthi* and *P. helianthi* while for *O. cumana* the damage was estimated by calculating attack frequency at ripening. Similar results were obtained at the attack of *A. helianthi* for ST1 and ST2 while at ST3 the intensity was lower. The attack of *P. helianthi* increased upon the sowing delay. The attack of *O. cumana* was influenced by the resistance of the hybrid and not by the ST.

Key words: *sunflower, fungal diseases, broomrape, sowing time*

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is the main oil crop in Romania being cultivated on 1.12 million ha in 2021 and 1.08 million ha in 2022 (INSSE, 2022). Sunflower is a temperate zone crop, which can behave well under different climatic and soil conditions (Canavar et al., 2010). Sowing period influence the severity of diseases being directly correlated with climatic conditions. It is one of the IPM solutions that can also be used in ecological agriculture.

Alternaria leaf spot attack is favored by humidity (rainfall for several days in a row) and heat (26-30°C) but especially the alternation of warm and humid periods with dry periods (Ion et Basa, 2021). It is present in all areas of sunflower culture in our country, the attack being more frequent in some years in the southern and southeastern areas of our country (Jinga, 1994). In Romania, for sunflower crop, three species of *Alternaria*: *Alternaria helianthi*, *Alternaria zinniae* and *Alternaria alternata* were noticed. Among them, *Alternaria helianthi* is the dominant species in all sunflower vegetation stages (Raranciuc et Pacureanu, 2002). Rust attack is favored by temperature of 18-25°C and the presence of water droplets on the leaf surface (GRDC, 2017). Till now 15 races of rust have been identified (Masirevic, 2016). Sunflower is the only crop plant parasitized by *O. cumana* (Ion et Basa, 2021). There are currently 8 broomrape races: A, B, C, D, E, F, G, H (Pacureanu-Joita, 2016). Rîșnoveanu et al. (2016) showed that new virulent populations of the parasite plant (broomrape) are present in Dobrogea.

Studies proved that beyond the influence over fungal diseases, sowing time influence also the emergence, flowering time, plant high, number of leaves, stem diameter, oil content (Petcu et al., 2010), dry matter (Sofield, 1977; Ahmed, 2015), fertile/infertile seeds (Baghdadi et al., 2014), head diameter (Allam et al., 2003) or yield (Radu et al., 2022) on sunflower.

Similar researches have to performed in all regions of Romania from time to time in order to help farmers to choose the proper hybrid and sowing time which will ensure the highest yield.

The aim of this research was to examine how different sowing dates influence the occurrence of Alternaria leaf spot (*Alternaria helianthi*) rust (*Puccinia helianthi*) and broomrape (*Orobanche cumana*) on six sunflower hybrids in the climatic conditions specific for Dobrogea area in 2021.

MATERIALS AND METHODS

Plant material and field trials. The experiment was carried out in the field experiments in the South of Tulcea county (Beidaud - 44º42' N latitude and 28º34' E longitude) during 2021 on a chernozem argiloiluvial soil under rainfed conditions. Two hybrids included in the study were certified (P64LE99 and FD15E27) and four were in the process of certification (DS001, DS002, DS003 and HS7083). They were sown at three different sowing time (ST) taking into account the Celsius degrees at the soil depth of 7 cm at 7 a.m.: ST1 at 5ºC (1st April), ST2 at 7ºC (17th April) and ST3 at 9ºC (23rd April). Sowing density was 55,000 germinable seeds ha^{-1}. The space between rows was 70 cm. The plot size was 210 m^2 (4.2 m x 50 m). The previous crop was winter barley. The weeds were controlled with herbicide Pantera 40 EC (40 g/l quizalofop-P-tefuryl) 0.8 L/ha applied at 2-4 leaves stage and a hoeing before the emerge of sunflower inflorescence.

Disease data collection. Disease severity on the field was assessed by visual observations of symptoms of leaf spot at flowering stage on 20 randomly selected plants in five replicates using a scale of 0–4 where: 0 = no disease; 1 = 1–25%; 2 = 26–50%; 3 = 51–75%; 4 = 76–100%. Disease severity (DS %) was calculated using the following formula: Disease severity $= \frac{(n*v)}{4N}*100$; where: n - is the number of plants in each category; v - is the numerical value of the symptom category; N - is the total number of plants, and 4 is the maximum numerical value of the symptom category.

For *O. cumana* the attack frequency was calculated counting the number of broomrape plants and divided it at to 20 sunflower plants which correspond to one replication.

Weather conditions. At Beidaud area during the sunflower growing period (April-August), the mean temperature has increased continuous from 9ºC (April) to 24.4ºC (June) and decreased slightly to 23.6ºC in August. The sum of rainfall for the same period was 400.8 mm sufficient for covering the sunflower water requirements for a good development which is over 400 mm (Pejic et al., 2009). Rainfall was irregular during the months of sunflower vegetative period, the rainiest month was June (147.7 mm) and the driest was August (32.2 mm) (Figure 1).

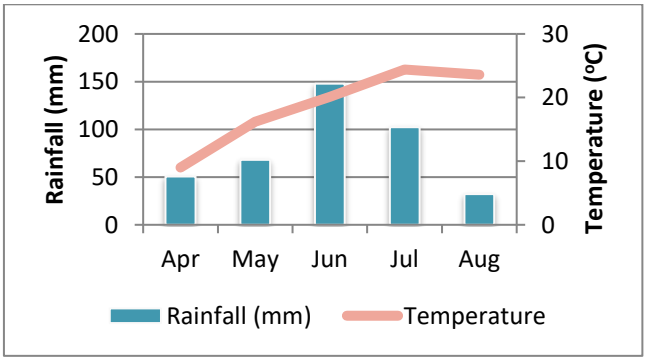

Figure 1. Average temperature (°C) and monthly distribution of rainfall (mm) during the sunflower growing season in 2021

Statistical analysis. Collected data were statistically analysed by ARM-9 software using ANOVA test analysis of variance (ANOVA) and means obtained were compared using the least significant difference (LSD) at 5%.

RESULTS AND DISCUSSIONS

The assessments for pathogens attack were performed in order to select the most tolerant hybrids, because after the flowering period it is difficult to apply a fungicide treatment.

For *A. helianthi* similar results were at ST1 and ST2 (46,7% and 48,7%) while at ST3 the intensity was lower (33,1%). For *P. helianthi* the attack intensity increased upon the sowing delay from 0,4% (SD1) to 7,4% (SD2) and to 16,1% (SD3). No significant difference were present for *O. cumana* between ST (Table 1) but with all of this a slight increase of the attack it is attributed the fact that broomrape seeds germinate at high temperatures (Grenz et al., 2008) In India Alternaria blight (*Alternaria lini*) of linseed decreased with the sowing delay and the yield were higher where the attack was lower (Pandey et al., 2019). In a study conducted in Brazil when five sowing epochs were studied the attack of *A. helianthi* and *Sclerotinia sclerotiorum* occurred when it sowed later due to climatic conditions that allowed this to occur. It is preferable that the sowing to be carried out so that the flowering phase does not overlap with a rainy period (Birck et al., 2016).

Table 1. Effect of sowing date on Alternaria leaf spot, rust and broomrape attack severity during 2021 sunflower growing season

Sowing time	*Alternaria helianthi* (DS %)	*Puccinia helianthi* (DS %)	*Orobanche cumana* No/20 plants
ST1	46.67a	0.38b	1.67-
ST2	48.70a	7.42b	1.89-
ST3	33.08b	16.08a	2.35-
LSD 5%	13.38	7.2	0.83
Standard Deviation	10.4	5.6	0.65

Different letters in columns differ at significant difference according to Tukey's HSD test; P< 0.05; "-": no significant difference

For *A. helianthi* the most tolerant hybrid was HS 7083 with DS – 31% while the most susceptible was DS 001 with DS – 51.91%. The DS for *P. helianthi* had considerable lower values compared with Alternaria leaf spot. The values ranged from 3.41% (DS 002) to 17.68% (HS 7083) (Table 2). Radu et al. (2019) tested a wide range of sunflower in Dobrogea are and concluded that as in our case *O. cumana* can be controlled using resistant hybrids.

The interaction between sowing date and hybrid showed that hybrid P64LE99 at ST1 and hybrid FD15E27 at ST2 were the most tolerant at A. helianthi attack while DS 003 at ST1, DS 001 and DS 002 at ST2 were the most susceptible. Only one hybrid was attacked by P. helianthi at SD1 and four hybrids were attacked at SD2. Hybrid P64LE99 proved a good behavior at broomrape attack being the less attacked while hybrid HS 7083 proved that it doesn`t possess genetic attributes to fight against this enemy (Table 3).

Table 2. Effect of hybrid on Alternaria leaf spot, rust and broomrape attack severity during 2021 sunflower growing season

Hybrid	*Alternaria helianthi* (DS %)	*Puccinia helianthi* (DS %)	*Orobanche cumana* No/20 plants
P64LE99	33.43ab	10.5ab	0.04c
DS 001	51.91a	5.26b	1.44b
DS 002	51.75a	3.41b	0.74bc
DS 003	49.58ab	3.5b	0.82bc
FD15E27	39.25ab	7.41b	1.9b
HS 7083	31b	17.68a	6.89a
LSD 5%	18.92	10.18	1.18
Standard Deviation	10.4	5.6	0.65

Different letters in columns differ at significant difference according to Tukey's HSD test; P< 0.05; "-": no significant difference

Table 3. Effect between sowing date and hybrid on Alternaria leaf spot, rust and broomrape attack severity during 2021 sunflower growing season

Sowing time	Hybrid	*Alternaria helianthi* (DS %)	*Puccinia helianthi* (DS %)	*Orobanche cumana* No/20 plants
ST1	P64LE99	26.05h	0e	2.0de
	DS 001	50.75bc	0e	17.3cde
	DS 002	55.75b	0e	16.5cde
	DS 003	64.25a	0e	17.5cde
	FD15E27	48.75bc	0e	28.5cde
	HS 7083	34.5efg	2.25e	119.5b
ST2	P64LE99	46.25cd	7.5d	0.3e
	DS 001	68a	0.25e	37.3cd
	DS 002	65.75a	0e	17cde
	DS 003	51.75bc	0e	7.3cde
	FD15E27	31e-h	9.25cd	43.3c
	HS 7083	29.5fgh	27.5a	122b
ST3	P64LE99	28gh	24a	0.5e
	DS 001	37ef	15.5b	32.3cde
	DS 002	33.75e-h	10.25cd	11cde
	DS 003	32.75e-h	10.5cd	24.5cde
	FD15E27	38de	13bc	42.5c
	HS 7083	29fgh	23.25a	172a
LSD 5%		8.26	4.81	36.65
Standard Deviation		6.55	3.81	25.82

Different letters in columns differ at significant difference according to Tukey's HSD test; P< 0.05; "-": no significant difference

Besides these two diseases present in the field of this research sowing date can influence other diseases behavior on sunflower. Vranceanu (1974b) showed a decrease in downy mildew attack (*Plasmopara helianthi*) when it sowed at the end of March compared to sowing in April.

Jinga et al. (1992) showed a reduced disease attack rate by sowing on April 5 compared to April 25: for *S. sclerotiorium* from 3.7 to 2.9%; for *Phomopsis helianthi* from 11.2 to 4.1% and for *Phoma macdonaldii* from 25.9 to 19.5%. However, the attack of *P. helianthi* was smaller in other years when sowing was carried out towards the end of the optimum period (5 May), due to the low presence of fungus picnospores in the air in the pronounced sensitivity phase of the host plant (Iliescu and Baicu, 1984). In India Shirshikar (2003) proved that sunflower necrosis disease caused by *Tobacco Streak Virus* – TSV is present especially when the sowing were performed in July and August which correspond with the pre rainy season when drought periods are presents and this might favor vector population.

Farmers of the same region should sow sunflower around the same date, to decrease pathogen dissemination from one field to another. Low initial disease infections are cancelled by accelerated increase of disease from another field.

CONCLUSIONS

In 2021 sunflower were attacked by two fungal diseases: *A. helianthi* and *P. helianthi*. Similar results were obtained at the attack of *A. helianthi* for ST1 and ST2 while at ST3 the intensity was lower. The attack of *P. helianthi* increased upon the sowing delay.

The attack of broomrape was determined predominantly by genetically resistance of each hybrid and not by the sowing time.

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