THE BEHAVIOR OF SOME SUNFLOWER HYBRIDS AT THE ATTACK OF THE MAIN PATHOGENS UNDER THE CONDITIONS OF THE TRANSYLVANIA PLAIN

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Abstract: *Sunflower is a plant of origin from North America, one of the four important cultures grown for oil, along with soy, rapeseed, and peanuts. The most common species is Helianthus annus L., which is cultivated all over the globe as an oil and ornamental plant. In Romania, it became the main oleaginous plant shortly, due to excellent conditions of culture. Climate change is occurring in Romania and is interacting with agroecological factors to increase biotic stress in sunflower. The uneven distribution of precipitation has increased the chances of infection with necrotrophic pathogens. The main objective of this paper was to study the dynamics of pathogens in the sunflower culture influenced by both the use of fertilizers and the genetic characteristics of the hybrids, correlated with the economic potential offered by pedo-climatic condition found in the Transylvania Plains area. Following the determinations made in the experimental field regarding the level of attack, we identified two pathogens (Diaporthe helianthi, respectively Plenodomus linquistii). We can say that the highest degree of attack was found in the case of Phomopsis stem canker, whit an average attack at 11.72 %. The second pathogen identified in the experimental field was noted, with a meager attack degree (below 2%). Of the six hybrids, the least susceptible to pathogen attack was the Adagio hybrid with 4.25% and the most sensitive Neoma hybrid with an attack degree of over 20%. Data analysis show that from hybrids sensitivity to the attack of pathogens point of view, they can be divided into three groups: Adagio and Klarika slightly sensitive, Gracia and Europe mean sensitive, Neoma and NHK 12MO10 with an above-average sensitivity. The main objective of this paper was to study the dynamics of pathogens in the sunflower culture influenced by both the use of fertilizers and the genetic characteristics of the hybrids, correlated with the economic potential offered by pedo-climatic condition found in the Transylvania Plains area.*

Keywords: ***sunflower, disease, pathogen, fertilization, Diaporthe helianthi, Plenodomus lindquistii***

INTRODUCTION

Sunflower is a plant of origin from North America, one of the four essential cultures grown for oil, along with soy, rapeseed, and peanuts. The most common species is *Helianthus annus* L., which is cultivated all over the globe as an oil and ornamental plant. In Romania, it became the main oleaginous plant. Due to the excellent conditions of culture, it reaches considerable achievements both in cultivation technology, in the yield, and oil extraction (VRÂNCEANU, 2000; MUNTEAN ET AL., 2014).

Climate change is occurring in Romania and is interacting with agroecological factors to increase biotic stress in sunflower. The uneven distribution of precipitation already observed has increased the chances of outbreaks of necrotrophic pathogens, like *Diaporthe*. (HULKE ET AL., 2019)

Diaporthe helianthi was assumed to be the single causal agent of Phomopsis stem canker, although several researchers suspected that the disease might be caused by more than one species of Diaporthe (Mathew et al., 2018). Nowadays, eight species of *Diaporthe* are documented, causing Phomopsis stem canker on sunflower worldwide (OLSON, 2017; THOMPSON, 2011).

The first report of a massive attack of Phomopsis stem canker on sunflower was in 1980 in Yugoslavia, (MARIC AND MASIREVIC, 1980). Many of these fields resulted in

significant yield reductions due to 50-80% of plant infection. Around the same time, the disease was also reported in Romania (ILIESCU ET AL., 1985).

Symptoms following Phomopsis attack are characterized by the appearance of spots on the leaves, stems, petioles, and under certain conditions also on the capitulum. On the leaves appear ellipsoidal brown spots, which initially settle on the edge of the leaf, at the end of one of the three primary nerves (HATMAN ET AL., 1989; LAZĂR ET AL., 1977; PÂRVU, 2010). Gradually, the spots progress in the form of a triangle with the tip directed towards the petiole, occupying in some cases the entire leaf. If the weather becomes very dry, the fungus stops before reaching the petiole. Later the spots become brownish-gray, with silver reflections, being surrounded by a yellow border, which represents the toxin secreted by the fungus (LAZĂR ET AL., 1977; PÂRVU, 2010; POPESCU, 1999).

On the stem, the attack starts from the insertion point of the petiole, when the respective leaf is necrosed, or internodal, by direct contact with a diseased leaf of a neighboring plant. The central part of the stain becomes gray, while the edges remain dark brown. The medullary tissues under the spots are almost destroyed, interrupting sap circulation, causing the upper part of the plant to wilt, or the stem to break. Stains on the stem can often be confused with those produced by other fungi (*Phoma, Sclerotinia, Verticillium*) (FLORIAN, 2018; PUIA, 2005; ULEA, 2003).

The measures to prevent this pathogen consist of cultivating tolerant hybrids, respecting a rotation in which the sunflower does not return sooner than 5-6 years, respecting the optimum sowing period, using a suitable density as well as balanced fertilization that will include all macro-elements in approximately equal proportions (POPESCU, 1999). The fertilization of the sunflower must necessarily take into account the economic component of this technological step (FRANZEN, 2016).

The second pathogen monitored in this work was *Plenodomus lindquistii* (anamorph *Phoma macdonaldii*). The attack of Phoma manifested by stem blackening, especially in the area of insertion of the petiole on the stem, hence the common name of the "black stem of sunflower." Frequently, at the base of the stem, large confluent spots are observed, which surround the stem like a black sleeve (FLORIAN, 2018).

The main objective of this paper was to study the dynamics of pathogens in the sunflower culture influenced by both the use of fertilizers and the genetic characteristics of the hybrids, correlated with the economic potential offered by pedo-climatic condition found in the Transylvania Plains area.

MATERIAL AND METHODS

In order to achieve the objectives, an experimental field was located in Cătina, Hodaie village, Cluj County. The natural relief is typical of the Transylvanian Plain. The total area of the experimental field was 1.36 ha, representing 12 variants, technological paths, and protective bands. Each variant had a width of 4.2 meters, which corresponds to the working width of the sower that was used for sowing, the length of the variant was 204 m, the total area of a single variant being 860 mp. The experience was seeded in a randomized block in three repetitions:

Factor 1- hybrid:
1. NHK 12MO10
2. EUROPA
3. GRACIA
4. NEOMA
5. KLARIKA
6. ADAGIO

Factor 2- fertilization: 1. NPK 18-46-0
2. unfertilized

The sowing was carried out on April 6, 2019, and on September 11, 2019, the experimental field was harvested. During the vegetation period, three observations were made in order to check the state of the crop under the phytosanitary protection aspect. After these examinations, the calculations were performed to determine the degree of attack of the pathogens. Attack was determined using the formula AD = (I X F) / 100, where I represents the intensity of the attack and F the attack frequency.

RESULTS AND DISCUSSIONS

Following the determinations made in the experimental field regarding the level of attack of the two pathogens mentioned above (*Diaporthe helianthi*, respectively *Plenodomus linquistii*) we can say that the highest degree of attack was found in the case of Phomopsis stem canker, whit an average attack at 11.72 % (Table 1). Their behavior can be observed to be very heterogeneous, varying between a meager degree of attack (Adagio hybrid, 4.11%), and over 20% at Neoma hybrid. This fact is also confirmed by the Duncan test, with significant differences between the six hybrids.

Table 1

Diaporthe helianthi level of attack on sunflower

Treatment	Attack degree	Duncan significance
Average	11.72 ^{Mt}	
NHK 12MO10	18.11 **	D
EUROPA	10.77	C
GRACIA	9.61	BC
NEOMA	21.42 ***	D
KLARIKA	6.32 ^{o}	AB
ADAGIO	4.11 ^{oo}	A
Mt-control	LSD (p 5%) – 4.17 DL (p 1%)- 5.66 DL (p 0.1%)- 7.68	DS 4.16

The second pathogen identified in the experimental field was *Plenodomus linquistii*, with meager attack degree (below 2%), with an average of 1.01% (table 2). Compared to this average, none of the six hybrids tested did show significant differences. It is noted, however, hybrid Europe, with the highest degree of attack, being the only one that exceeded the threshold of 1.5% degree of attack.

Table 2

Plenodomus lindquistii level of attack on sunflower

Treatment	Attack degree	Duncan significance
Average	1.01^{Mt}	
NHK 12MO10	0.47	AB
EUROPA	1.71	C
GRACIA	0.93	ABC
NEOMA	1.19	ABC
KLARIKA	1.63	BC
ADAGIO	0.14	A
Mt-control	LSD (p 5%) – 1.09 DL (p 1%)- 1.48 DL (p 0.1%)- 2.01	DS 1.09

One aim of these works was to test the effect of fertilizers on the incidence of the main sunflower diseases. Thus, in the experimental field, fertilized plots were introduced (NP 18-46, 200 kg/ha).

The graph in Figure 1 shows that the degree of attack increased on average by about 2.5 % on fertilized parcels. The differences between the two plots are significant (Test Duncan).

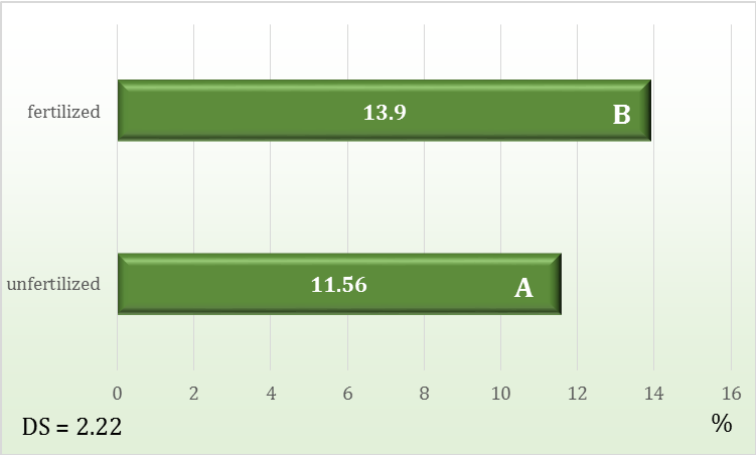

Figure 1. The influence of fertilization on the total attack degree

Comparing the six hybrids (Figure 2) in terms of the total degree of attack, it can be seen that, compared to the average, the Adagio hybrid has very significant negative differences, and the Neoma hybrid has very significant positive differences.

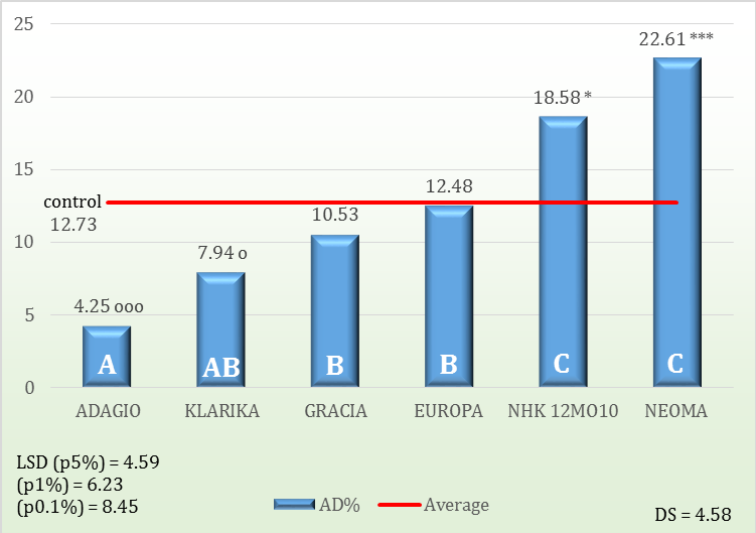

Figure 2. Total attack degree levels on sunflower hybrids

Duncan analysis shows that from hybrids sensitivity to the attack of pathogens' point of view, they can be divided into three groups: Adagio and Klarika slightly sensitive, Gracia and Europe mean sensitive, Neoma and NHK 12MO10 with an above-average sensitivity.

For production, it can be observed that on all hybrids, fertilization has led to production increases between 900 and 1400 kg/ha, depending on the genetic potential of each one.

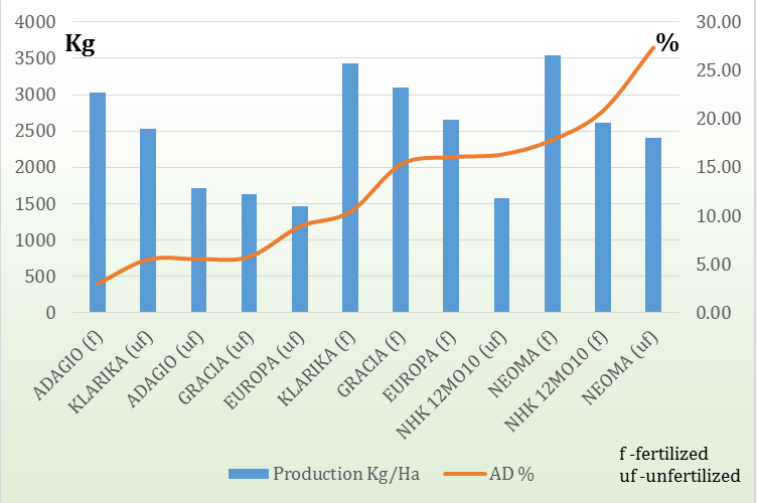

Figure 3. The relation between the production and total attack degree

Comparing the productions with the degree of attack (Figure 3), noted for each plot, it can be seen that there are hybrids with a higher resistance to attack of the two pathogens, such as Adagio, which in the fertilized variant had an attack degree of less than 5%, and in the unfertilized version 5.5%. The differences in the production of this hybrid can be attributed only to fertilization. At the other end, there is the Neoma hybrid, with the highest levels of attack but with productions similar to the Adagio hybrid. This reveals that the Neoma hybrid can be considered tolerant to the attack of the two pathogens. It can also be noticed the hybrid NHK12MO10, whose production was relatively low, being in opposite relation to the degree of attack noted.

CONCLUSIONS

In the conditions of 2018, in the Transylvania Plain, the attack of the pathogen *Diaporthe helianthi* was, on average 11.72%, and for *Plenodomus linquistii* 1.1%. Under the conditions of the experimental field, fertilization increased the degree of attack, but this was offset by production increases recorded by the six hybrids. Of the six hybrids, the least susceptible to pathogen attack was the Adagio hybrid with 4.25% and the most sensitive Neoma hybrid with an attack degree of over 20%. Following the experiment, under the conditions of Transylvania, we can recommend the cultivation of Adagio, Klarika, Gracia, and Neoma hybrids, but only if additional fertilization is introduced in the cultivation technology..

BIBLIOGRAPHY

FLORIAN, V., ȘANTA, V., PUIA C., FLORIAN T., 2018 – Manifestarea Patogenilor din Cultura de Floarea Soarelui în Condițiile Climatice din Centrul Câmpiei Transilvaniei, Revista Protecția Plantelor, vol. Vol. XXVIII, nr. 100, pag 7-16

FRANZEN, D. 2016. Fertilizing Sunflower. North Dakota State University, Extension Publication SF713. Fargo, ND.

HATMAN M., I. BOBEȘ, AL. LAZĂR, C. GHEORGHIEȘ, C. GLODEANU, V. SEVERIN, C. TUȘA, I. POPESCU, I. VONICA, 1989 – Fitopatologie, Editura didactică și pedagogică, București

HULKE, B., MARKELL, S., KANE, N., MATHEW, F., 2019 – Phomopsis stem canker of sunflower in North America: Correlation with climate and solutions through breeding and management. OCL. 26. 13. 10.1051/ocl/2019011.

ILIESCU, H., JINGA, V., CIUREA, A., JONITA, A. 1985 – Investigations related to the prognosis of sunflower stem canker (D. helianthi). Helia 8: 51-56.

LAZĂR AL., I. BOBEȘ, I. COMEȘ, A. DRACEA, M. HATMAN, 1977 – Fitopatologie, Editura didactică și pedagogică, București

MARIC, A., MASIREVIC S., 1980 – Pojava sive pegavosti stable (Phomopsissp.) do sada nepoznale bolesti suncokreta. Zašita Bilja 12: 421-423.

MATHEW, F., HARVESON, R., GULYA, T., THOMPSON, S., BLOCK, C., MARKELL, S., 2018 – Phomopsis Stem Canker of Sunflower. *Plant Health Instructor.* DOI: 10.1094/PHI-I-2018-1103-01

MUNTEAN L. S., CERNEA S., DUDA M.M., MUNTEAN S., MORAR G., VÂRBAN D. I., MOLDOVAN, C., 2014 – Fitotehnie, Editura RISOPRINT, Cluj-Napoca

OLSON, T. R., 2017 – Managing Phomopsis Stem Canker of Sunflower Using Improved Diagnosis and Quantification of the Causal Pathogens" (2017).Theses and Dissertations. 1184.http://openprairie.sdstate.edu/etd/1184

PÂRVU M., 2010 – Ghid practic de fitopatologie, Editura Presa Universitară Clujeană

POPESCU GH., 1999 – Fitopatologie agricolă, Editura 1999

PUIA C. E., 2005 – Fitopatologie. Patografie. Etiologie, Editura Risoprint, Cluj-Napoca

THOMPSON, S. M., TAN, Y. P., YOUNG, A. J., NEATE, S. M., AITKEN, E. A. B., SHIVAS,R. G. 2011 – Stem cankers on sunflower (Helianthus annuus) in Australia reveal a complex of pathogenic Diaporthe(Phomopsis) species. Persoonia 27: 80-89.

ULEA E., 2003 – Fitopatologie, Ed. "Ion Ionescu de la Brad" Iasi, 286 p., ISBN 973- 8014-97-2.

VRÂNCEANU A.V., 2000 – Floarea soarelui hibridă, Editura Ceres, București