# INFLUENCE OF RAINFALIS AND SUNFLOWER GROWTH STAGE ON THE APOTHECIA DEVELOPMENT OF SCLEROTINIA SCLEROTIORUM

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SUMMARY

The formation of apothecia was in correlation with higer amounts of rainfalls (more then 10 mm and three rainy days weekly) and the growth stage of sunflower. Before butonisation and after withering of leaves no apothecia have been found under ideal weather conditions. The apothecia of the fungus appeared in all sowing times (from begining of April until the end of July) in both years of investigations. More generations of this reproductive organs were observed during vegetation period of sunflower. The development of apothecia decreased after reaching a maximal number. The temperature was not a limiting factor for production of apothecia. The Sclerotinia head rot appeared only in the six sowing times, in 1986, with much less inoculum in comparison with previous year because of coincidence of longer wet period and flowering stage of plants.

## INTRODUCTION

Sclerotinia root and basal rot is one of the most important sunflower diseases in Yugoslavia. It appears every year causing great damages in the main growing regions of sunflower of the country. However, a heavy infestation of Sclerotinia head rot could be found in some years in different regions and on individual fields. This type of the disease became more important by introducing the second generation of the middle late domestic sunflower hybrids in the commercial production. Heavier attack of Sclerotinia stem rot occurr very rare.

Althgouh there are some differences in the reaction of sunflower hybrids to Sclerotinia head rot, more efficient control measures have to found. Some fungicides are very fungitoxic to S. sclerotiorum in vitro. In some trials and in commercial fields a positive effect has been achieved in the control of Sclerotina head rot by using these chemicals. However, in many cases chemical control of the disease was not enough effective. Among other questions, much more has to be done in studying the epidemiology of S. sclerotiorum under different agroecological conditions in order to develop a suitable forecasting metohd of the disease development. Therefore, the main aim of our investigation was to study the importance of apothecia development under the condition of different sowing times of sunflower and its influence on the Sclerotinia head rot incidence.

## MATHERIALS AND METHODS

These studies were carried out during two years period in the field trials on the Experimental Station Rimski Šančevi, with nine (1985) and twelve (1986) sowing times of sunflower, respectively. Two domsetic hybrids were included in the trials. A randomized block design was applied on the trials, with four repetitions and with a surface of a basic plot of 24 $m^2$. A usual spacing of plants between rows and within the row was applied (70 X 30 cm).

The apothecia of the fungus were counted every seven days between the two imiddle rows of plants (3,36 $m^2$) in every basic plot and in all repetition after emergence till the end of sunflower vegetation. The stage of plant development was noted in the same time on one hybrid (NS-H-15). The growth stage of the other hybrid (NS-H-45) was later for about 5-7 days. The average weekly precipitation and temperature, and rainy days between the two counting times has been taken from a metheorological station, located about 500 m from the trials. The obtayned results

of the apothecia development were summerized only for three sowing times in both years of investigation (Tab. 1,2). The occurence of the diseases (Sclerotina root, rot, head rot, stem rot) was noted every 10 days on 100 plants in all repetitions of the trials. The infestation of Sclerotina head is only presented in this report (Tab. 3).

## RESULTS

The first apothecia of the fungus has been observed usualy in butonization of plants in all sunflower sowing times, in both years of investigations. Before that time and after withering of leaves (maturing stage) there were no apothecia formation under ideal weather conditions. This phenomen could be explained by the mycroclimatic condition of sunflower crop at that period of vegetation which protect the soil surface from insolation and aeration, keeping it wet longer after a rainy period. Therefore, the dynamics of apotheca formation were very different, depending not only from metheorological factors but also from the sowing time of sunflower.

The quantity of rainfalls and number of rainy days were the most important factors which influenced the apothecia development. Abundant production of these reproductive organs of the parasite has been found in the crops of the first sowing times in 1985 (1.04, 10.04, 20.04, 1.05, 10.05) due to very frequent and high quantity rainfalls during May (93,2 mm, 16 rainy days) and Jun (77,8 mm 19 rainy days). Much less of apothecia was found in 1986, because of smaler amounts of rainfalls and less of rainy days during May (50,8 mm, 9 rainy days) and Jun (50,4 mm, 11 rainy days) in comparation with with the previous year. The temperature was not a limiting factor for apothecia production. The apothecia of S. sclerotiorum could be found at any time during period between butonisation and withering of leaves, in all planting times of sunflower, after three rainy days with more then 10 mm of precipitations weekly.

More generations of apothecia were produced during vegetation period of sunflower in all sowing times of sunflower in both years of investigation. After reaching a maximal number, the apothecia formation decreased under ideal weather conditions. In spite of aboundunt presence of apothecia during 1985, no Sclerotina head rot of sunflower was noted. This could be explained by the dry weather condition during flowering time of plants (July, August, September) in the most of the tested planting times of sunflower. However, the disease occurred in first six planting times of sunflower, during 1986,with less inoculum potential of the parasite, because of the wet weather in July (77,1 mm, 16 rainy days). No disease occurred in later sowing times because the dry weather prevailed during flowering of plants (August, September). Heavier attack of Sclerotina head rot has been found on the more susceptible hybrid (NS-H-45). There was a good correlation between a longer preiod of wet weather during flowering time and incidence of the disease.

## DISCUSSION

There are different data in the literature about the optimal condition for apothecia development of S. sclerotiorum. According to some authors, optimal temperature for apothecia formation are 19-22$^{0}$C (Krasnokutskaja, 1967),10$^{0}$C (Abavi and Grogan, 1975) 7-11$^{0}$C (Krüger, 1976). The temperature was not a limiting factor for apothecia development in two years of our field experiments. The dynamic of apothecia formation depends from quantity and the distribution of rainfalls during vegetation (Hartill, 1980). According to the results of Lamarque (1983), four generations of apothecia have been observed during sunflower vegetation. In the periods with less precipitations and with longer droughts, no apothecia were found in these experiments. She also pointed out that apothecia could be found

before the emergence of sunflower if the soil is wet. We have never observed formation of apothecia in our trials before butonisation and after withering of leaves regardless of weather conditions and soil moisture. This is probably owing to more intensive insolation in our region and its negative effect on the evolution of these reproductive organs. We also came to the conclusion that dynamics of apothecia production is correlated with havy rains and with more rainy days only in the mentioned growth period of sunflower. It seems that there are enough inoculum potential of the parasite for heavier infestation of sunflower head in all crops with different planting times. Therefore, this parameter cannot be used for a forecasting method of the disease development. The intensity of Sclerotina head rot was in a correlation with coincidence of flowering of plants and wet weather at this growth stage of sunflower. This is in agreement with the results of previous investigations (Lamarque and Rapily, 1981) that infection of sunflower head take place during flowering time in the presence of free water more then 42 hours.

LITERATURE

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Tab. 1. The influence of rainfalls and growth stage of Sunflower on apothecia of S.sclerotiorum during 1985.

| Date of counting | | Precipit. mm | Rainy days | Average t° | Hybrid NS-H-45 Time of sowing | | | Hybrid NS-H-15 Time of sowing | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | April 10 | May 20 | Jun 20 | April 10 | | May 20 | | Jun 20 | |
| | | | | | apoth. $m^2$ | apoth $m^2$ | apoth $m^2$ | Sunf stage | apoth. $m^2$ | Sunf stage | apoth. $m^2$ | Sunf. stage | apoth. $m^2$ |
| 17 | Jun | 13,9 | 5 | 16 | 15,4 | - | - | $E_1$ | 15,1 | $B_2$ | - | | - |
| 24 | " | 22,3 | 5 | 15 | 17,2 | 0,1 | - | $E_3$ | 17,8 | $B_3$ | - | | - |
| 01 | July | 15,1 | 4 | 17 | 12,7 | 0,3 | - | $F_1$ | 12,9 | $B_4$ | 0,5 | $A_1$ | - |
| 08 | " | 9,1 | 3 | 18 | 1,2 | - | - | $F_3$ | 3,4 | $E_1$ | - | $A_2$ | - |
| 15 | " | 5,9 | 2 | 20 | 0,4 | 0,7 | - | $F_4$ | 1,3 | $E_3$ | 1,0 | $B_2$ | - |
| 22 | " | 14,0 | 2 | 23 | 0,4 | 1,5 | - | Mo | 0,5 | $E_4$ | 5,0 | $B_4$ | - |
| 29 | " | - | - | 22 | - | - | - | | - | $F_3$ | 0,3 | $E_1$ | - |
| 05 | August | 4,1 | 1 | 23 | - | - | - | | - | $F_4$ | - | $E_2$ | - |
| 12 | " | 19,4 | 4 | 19 | 0,5 | 8,1 | 1,9 | | 2,6 | Mo | 12,9 | $E_3$ | 2,4 |
| 19 | " | - | - | 24 | - | - | - | | - | | - | $E_4$ | - |
| 26 | " | 0,1 | 1 | 23 | - | - | - | | - | | - | $E_4$ | - |
| 02 | Sept. | 56,4 | 4 | 19 | - | 3,3 | 11,8 | | 0,1 | | 6,0 | $F_1$ | 6,5 |
| 09 | " | 6,0 | 4 | 17 | - | - | - | | - | | - | $F_3$ | - |
| 16 | " | 4,0 | 2 | 14 | - | - | - | | - | | - | | - |
| 23 | " | - | - | 19 | - | - | - | | - | | - | | 1,1 |

Sunflower stages: $A_1$: germination, $A_2$: cotiledon, $A_3$-two leaves, $A_4$-four leaves, $B_2$-six leaves, $B_3$-ten leaves, $B_4$-six-ten leaves, $E_1$-butonisation, $E_2$-buton 2-3 cm, $E_3$-buton 4-5 cm, $F_1$-beg. of flower, $F_3$-full flower, $F_4$-end of flower, Mo-begining of ripening.

Tab. 2. The influence of rainfalls and growth stage of sunflower on apothecia development of S.sclerotiorum during 1986.

| Date of counting | Precipit. mm | Rainy days | Average t° | Sowing time-hybrid NS-H-45 April 10 apoth. $m^2$ | May 19 apoth. $m^2$ | Jun 19 apoth. $m^2$ | Sowing time-hybrid NS-H-15 April 10 Sunf. stage | apoth. $m^2$ | May 19 Sunf. stage | apoth. $m^2$ | Jun 19 Sunf. stage | apoth. $m^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.06 | 15,3 | 2 | 16 | 0,2 | - | - | $E_3$ | 0,4 | $A_3$ | - | | - |
| 19.06 | 18,5 | 4 | 22 | 0,6 | - | - | $E_4$ | 1,1 | $A_4$ | - | | - |
| 26.06 | - | - | 22 | - | - | - | $F_3$ | - | $B_4$ | - | | - |
| 03.07 | 21,3 | 5 | 19 | 6,5 | - | - | $F_4$ | 6,5 | $B_4$ | - | $A_2$ | - |
| 10.07 | 30,3 | 3 | 21 | 4,5 | 1,4 | - | Mo | 3,9 | $E_2$ | 2,7 | $A_3$ | - |
| 17.07 | 9,5 | 4 | 18 | 3,0 | 3,0 | - | | 1,5 | $E_3$ | 7,5 | $A_4$ | - |
| 24.07 | 21,5 | 6 | 19 | 3,2 | 3,7 | - | | 0,4 | $E_4$ | 6,9 | $B_3$ | - |
| 31.07 | 2,4 | 1 | 20 | - | - | - | | - | $F_1$ | - | $B_4$ | - |
| 07.08 | 4,4 | 1 | 25 | - | - | - | | - | $F_3$ | - | $E_3$ | - |
| 14.08 | 1,2 | 1 | 24 | - | - | - | | - | $F_4$ | - | $E_4$ | - |
| 21.08 | 0,3 | 1 | 23 | - | - | - | | - | Mo | - | $F_1$ | - |
| 28.08 | 11,7 | 3 | 19 | - | 0,1 | 0,4 | | - | | - | $F_3$ | 0,4 |
| 04.09 | 22,4 | 2 | 17 | - | 0,1 | 1,3 | | - | | - | $F_4$ | 0,4 |
| 11.09 | - | - | 18 | - | - | - | | - | | - | Mo | - |
| 18.09 | - | - | 21 | - | - | - | | - | | - | | - |
| 25.09 | 0,2 | 1 | 16 | - | - | - | | - | | - | | - |

Sunflower stages: $A_1$-germination, $A_2$-cotiledon, $A_3$-two leaves, $A_4$-four leaves, $B_2$-six leaves, $B_3$-ten leaves, $B_4$-sixteen leaves, $E_1$-butonisation, $E_2$-buton 2-3 cm, $E_3$-buton 4-5 cm, $E_4$-buton 7-8 cm, $F_1$-beg. of flowering, $F_3$-full flowering, $F_4$-end of flowering, Mo-maturing.

Tab. 3. Occurance of Sclerotinia head rot (infected heads %) in some of sowing dates of sunflower during 1986

| Date of rating | Precipit. mm | Rainy days | Aver $t^0$ | Sowing time 3.04 Sunf. stage | 3.04 Rot heads | 10.04 Sunf. stage | 10.04 Rot heads | 18.04 Sunf. stage | 18.04 Rot heads | 29.04 Sunf. stage | 29.04 Rot heads | 19.05 Sunf. stage | 19.05 Rot heads | 19.06 Sunf. stage | 19.06 Rot heads |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hybrid NS-H-15** | | | | | | | | | | | | | | | |
| 12-30 06 | 90,8 | 15 | 19,5 | | - | | - | | - | | - | | - | | - |
| 10.07 | 45,7 | 6 | 20,0 | Mo | - | $F_4$ | - | $F_2$ | - | $F_1$ | - | $E_2$ | - | $B_2$ | - |
| 20.07 | 13,1 | 6 | 19,0 | | 0,2 | Mo | - | $F_3$ | - | $F_3$ | - | $E_3$ | - | $B_3$ | - |
| 30.07 | 20,3 | 5 | 19,0 | | 1,3 | | 1,3 | Mo | 2,9 | $F_4$ | 2,2 | $F_1$ | - | $B_4$ | - |
| 10.08 | 4,4 | 1 | 24,0 | | 2,3 | | 2,3 | | 3,8 | Mo | 5,4 | $F_3$ | - | $E_3$ | - |
| 23.08 | 4,5 | 3 | 23,0 | | 2,5 | | 2,7 | | 4,5 | | 6,5 | $F_4$ | - | $E_4$ | - |
| 01.09 | 31,1 | 4 | 19,0 | | 2,7 | | 2,7 | | 4,5 | | 7,4 | Mo | - | $F_4$ | - |
| 10.09 | - | - | 17,0 | | 2,7 | | 2,7 | | 4,5 | | 7,6 | | - | $F_3$ | - |
| 20.09 -9.10 | 4,3 | 3 | 16,0 | | - | | - | | - | | - | | - | $F_3$ $F_4$ | - |
| **Hybrid NS-H-45** | | | | | | | | | | | | | | | |
| 12-30.06 | 90,8 | 15 | 19,5 | | - | | - | | - | | - | | - | | - |
| 10.07 | 45,7 | 6 | 20,0 | | - | | - | | - | | - | | - | | - |
| 20.07 | 13,1 | 6 | 19,0 | | - | | - | | - | | - | | - | | - |
| 30.07 | 20,3 | 5 | 19,0 | | 1,6 | | 5,9 | | 7,2 | | 1,3 | | - | | - |
| 10.08 | 4,4 | 1 | 24,0 | | 5,5 | | 9,6 | | 13,6 | | 6,7 | | - | | - |
| 23.08 | 4,5 | 3 | 23,0 | | 7,5 | | 12,7 | | 16,0 | | 8,3 | | - | | - |
| 01.09 | 31,1 | 4 | 19,0 | | 7,8 | | 13,7 | | 16,7 | | 8,3 | | - | | - |
| 10.09 | - | - | 17,0 | | 7,8 | | 14,1 | | 17,0 | | 8,7 | | - | | - |
| 20.09-9.10 | 4,3 | 3 | 16,0 | | - | | - | | - | | - | | - | | - |