BREEDING FOR *SCLEROTINIA* TOLERANCE IN SUNFLOWER

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Abstract

White rot (*Sclerotinia sclerotiorum*) is one of the most destructive diseases of sunflower. We conducted an investigation in which 17 inbred lines (+ two checks) and 12 population of eight wild species were screened for resistance to the pathogen, using three inoculation methods.

The results obtained indicated that the methods of introducing sclerotia in the soil at the time of sowing and inserting the inoculum into wounded stems were not suitable for testing the lines. In the case of the wild species, best results were produced with the latter method. *H. maximiliani* (1631) demonstrated a high level of resistance to white rot.

The inoculation method in which the inoculum was applied to the soil near the stem showed that the lines NS-JM-65 and NS-JM-64 exhibited a high level of tolerance to *Sclerotinia* root rot.

Introduction

White rot caused by the fungus *Sclerotinia sclerotiorum* (Lib.) de Bary is the major disease of sunflower in countries with the humid climate. In extremely humid years, the entire production may perish. In countries with the moderate climate, the pathogen offers problems in rainy years.

Sclerotinia sclerotiorum is a facultative polyphagous parasites which attacks a variety of wild plants and agricultural crops. This explains why the selection for resistance has been unsuccessful, despite numerous attempts. It is certain that the cultivated sunflower does not possess genetic sources of resistance to the pathogen. Breeding work is further complicated by the three forms of the disease.

Inoculation techniques have been used in many breeding programs aimed at discovery of sources of resistance to the pathogen. Here is a selection of them: MANCL AND SHEIN, 1982; VEAR AND TOURVIEILLE DE LABROUHE, 1984; SEDUN AND BROWN, 1987; ROBERT ET AL., 1987; KHALID, 1992; etc.

The common shortcoming of the inoculation techniques applied is that they could not simulate the natural infection completely. Consequently, many cultivars declared as tolerant performed disappointingly in commercial production.

Sources of resistance to *Sclerotinia sclerotiorum* in sunflower have been reported by numerous researchers: MANCL AND SHEIN, 1982; VEAR AND TOURVIEILLE DE LABROUHE, 1984; ROBERT ET AL., 1987; GULYA ET AL., 1989; MILLER ET AL., 1992.

The objective of this investigation to screen several inbred lines and wild species for resistance to white rot, using three inoculation techniques.

Material and Method

The material screened for resistance to *Sclerotinia sclerotiorum* involved 17 inbred lines and 12 populations of wild species. The lines had been selected on the basis of the different levels of tolerance exhibited in natural conditions, using the susceptible line Ha 98 and the medium tolerant hybrid NS-H-45 as the checks. The lines and the wild species tested are listed in Table 1.

The small plot for the cultivars included 8 rows, 12 plants in the row, in three replications. Experiments were conducted in the course of 1990 and 1991, in a plot heavily irrigated to maintain high soil moisture and relative air humidity.

With the wild species, each treatment consisted of four pots filled with a mixture of compost and sand at the ratio 1:1. Again, the pots were heavily watered.

The following inoculation techniques were used:

Method I - 2-3 sclerotia introduced into the soil together with the sowing of sunflower seeds.

Method II - the inoculum introduced 2 cm below soil surface, near the root system, at the stage of flowering. The inoculum was prepared on sterilized oat grains (MANCL AND SHEIN, 1982).

Method III - inoculating plants with the inoculum identical to that used in method II. Plants were wounded with an awl, the inoculum inserted and the wound covered with damp cotton wad and insulated by foil.

Two rows in each small plots and one out of four pots were not inoculated. These served as checks. All the inoculated plants were checked four times.

Tab. 1 - Inbred lines and wild species tested

Inbred lines		Wild species
1. NS-CMS-I 237 B	13. NS-JM-64	1. *H. mollis* (1929)
2. NS-CMS-I 218 B	14. NS-H-45 (check II)	2. *H. nuttallii* (1996)
3. NS-CMS-I 166 B	15. NS-58-ARG-14-14	3. *H. nuttallii* (2000)
4. NS-JM-78	16. NS-28-ARG-6-6	4. *H. rigidus* (72272)
5. NS-JM-53	17. NS-3-ARG-1-8	5. *H. rigidus* (1843)
6. NS-JM-74-1	18. NS-25-ARG-5-19	6. *H. decapetalus* (1922)
7. NS-JM-65		7. *H. tuberosus* (1698)
8. NS-JM-69		8. *H. tuberosus* (1700)
9. NS-JM-40		9. *H. grosserratus* (1689)
10. NS-JM-74-2		10. *H. maximiliani* (1631)
11. NS-JM-70-2		11. *H. hirsutus* (1536)
12. NS-JM-70-1		12. *H. tuberosus* (NS-1)

Results

Our results confirmed those of previous researchers who considered method I as unsatisfactory. On the other side, method III was too destructive for the lines. For these reasons, the results obtained with these two methods will be discussed briefly.

In the case of the wild species, only method III provided satisfactory results.

For the sake of brevity, the paper will discuss only the two-year average degrees of infection for the lines and the percentages of healthy plants for the wild species.

Method II was found to be acceptable for breeding purposes. The lines NS-JM-65 and NS-JM-64, which are genetically close, exhibited a high degree of tolerance to root rot. With these lines, the percentage of infection was below 10% (Graph 1). The infection rates with the susceptible line Ha 98 and the medium tolerant hybrid NS-H-45 were 83.7% and 76.4%, respectively. In the case of the line NS-JM-40, all inoculated plants succumbed to root rot.

In addition to the two highly tolerant lines, the line NS-JM-70-2 could be considered as satisfactorily tolerant (16.5%). Five lines had the percentages of infection between 30% and 40%, the remaining lines were susceptible.

The results obtain seem to indicate that the tolerance to root rot and that to head rot are controlled by different mechanisms. The results for the line NS-JM-65 further strengthen this

point for it had the lowest basal stem rot and the highest head rot. The second most tolerant line, NS-JM-64, behaved similarly.

Further to the point, the most sensitive line in method III, NS-JM-40, did not have a single instance of head rot.

When considering the tolerance to basal stem rot exhibited by the lines NS-JM-65 and NS-JM-64, it should be mentioned that these lines were also tolerant to *Phomopsis*. It is certain that these lines have a high breeding value and it is no surprise that they are intensively used for breeding highly tolerant hybrids.

Another part of this investigation dealt with several wild species which were screened for resistance to *Sclerotinia* root rot.

The robust structure of the root tissues in most wild sunflower species has rendered methods I and II ineffective. Only method III produced reliably discriminative results.

The two-year testing indicated that the *H. maximiliani* population 1631 probably possesses a high degree of tolerance to white rot (Graph 2). Only this population fully obstructed the development of the fungus in method III. The resistance mechanism of the inoculated plants stopped the development of the fungus and even strengthened the stem at the infection court by developing a callus. It is a pity that we could not inoculate the heads of these plants and thus check the reaction of the population to all three forms of white rot.

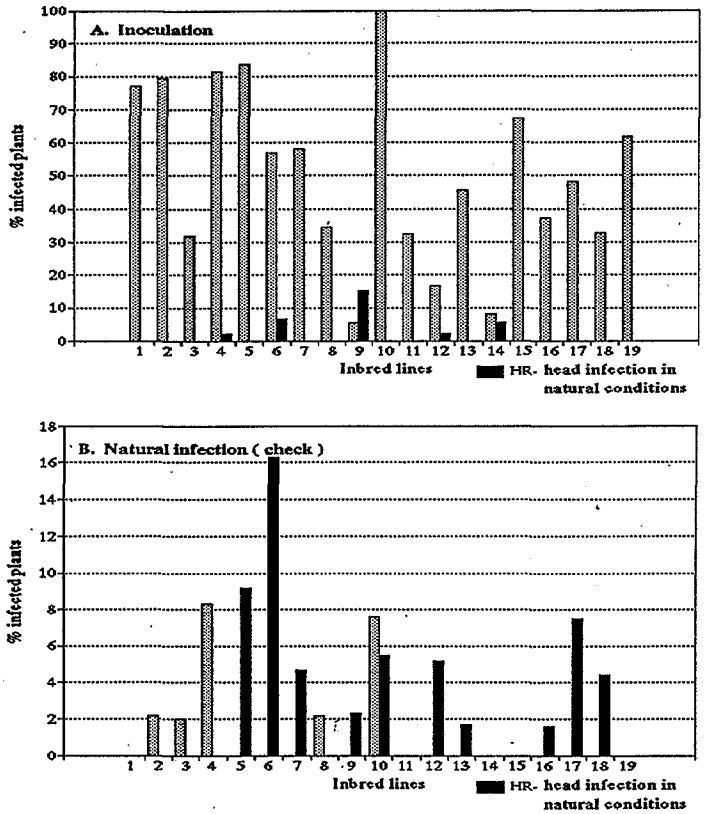
Discussion

The investigation showed that the introduction of sclerotia into the soil at the time of sowing does not bring positive results. The inoculation method which includes the wounding of plant tissues is not applicable for cultivated genotypes. However, this method brings very good results with some wild species, on account of a specific structure of their plant parts.

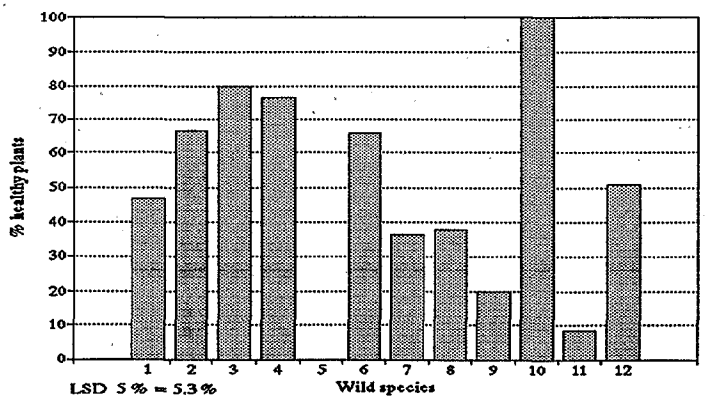
Although this was not the target of this investigation, the results obtained are confirmed those of ROBERTS ET AL. (1987) who found the mechanisms of tolerance to the various forms of white rot in sunflowers to be controlled by different genetic and other processes.

If optimum conditions for the pathogen's development are created by irrigation, it is possible to successfully screen sunflower cultivars for resistance to the basal form of white rot in the open field.

Graph 1. Intensity of white rot (*Sclerotinia sclerotiorum*) attack after inoculation (A) and in natural infection (B)- basal stem infection.



Graph 2. Percentage of healthy stems in wild species inoculated with *Sclerotinia sclerotiorum.*



Conclusion

The following conclusions were drawn on the basis of the two-year investigation in which the selected lines and wild species were screened for resistance to white rot (*Sclerotinia sclerotiorum*) using different inoculation methods.

The lines NS-JM-65 and NS-JM-64 exhibited a high degree of tolerance to root rot. The line NS-JM-70-2 was satisfactorily tolerant.

Among the wild species tested, only *H. maximiliani* (1631) demonstrated a high degree of resistance to white rot.

The results obtained do not discriminate the material tested regarding the reaction to head rot.

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