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WILD SUNFLOWER SPECIES - SOURCES OF RESISTANCE TO THE SUNFLOWER MOTH (*Homeosoma nebulella* Hubner; *Homeosoma electellum* Hulst)

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SUMMARY

Introduction of sunflower varieties and hybrids is the best protection against the sunflower moth. Sunflower resistance to the pest depends on the presence of the phytomelanin layer in the pericarp. An analysis of 23 wild sunflower species with a saturated solution of bichromate (K_2CrO_7) and sulphuric acid (H_2SO_4) has shown that the perennial species tested have a thicker average phytomelanin layer that the annual species. Differences have also been found between the species as well as between populations of individual species. Of the 84 populations tested, only 6 of these had the phytomelanin layer in 100% of the achenes tested.

Key words: Sunflower, wild species, resistance, sunflower moth.

INTRODUCTION

The sunflower moth is an important pests in all sunflower-growing regions in the world. There are two types of the pest: the European type *Homeosoma nebulella* Hubner, and the American type, *Homeosoma electellum* Hulst. The former is widespread in Europe and Asia, the latter in Mexico, the United States, and some provinces of Canada (Rogers and KReitner, 1983). Because the insect lays eggs on anthers during flowering, application of insecticides is limited because it would harm the useful insects, primarily pollinating insects. In their four-year trial, Rogers et al. (1982) found a high negative correlation between the percentage of damaged achenes and the presence of the phytomelanin layer, of -0.93. The phytomelanin layer fills the intercellular space between the hypodermis and the sclerenchyma. While European entomologists consider the phytomelanin layer primarily as a physical barrier, American entomologists attribute the protective role of the phytomelanin layer to its toxic effect on the metabolism of the pest. The conclusion of the American researchers has been based on the results of the tests which monitored the mortality and development rate of sunflower moth larvae fed with pericarps with and without the phytomelanin layer. According to Perestova (1989), first investigations of sunflower resistance to the sunflower moth were conducted by Saharov (1925) and Plachek (1930).

Introduction of resistant varieties and, later on, hybrids has proved that selection and breeding are the best method of sunflower protection against the pest. Shapiro (1975), as cited by Rogers and Kreitner (1983), reported that the phytomelanin layer saved USD 480 million to the Soviet sunflower growers in the period 1945-1975. Rogers et al. (1984) registered three lines resistant to *H. electellum*, SFM 1, SFM 2, SFM 3, which had been

developed by interspecific hybridization. Although an investigation of Seiler (unpublished) showed that all of the 50 sunflower species tested did possess the phytomelanin layer, open questions have remained, of differences in the phytomelanin layer and whether a species may be generally pronounced to possess the phytomelanin layer although it is not present in individual populations of the species. The results of Perestova (1976, 1989) confirmed the presence of the phytomelanin layer in the wild sunflower species, but she also found that the cultivated sunflower differs from wild species in the time of the beginning of the fomation of the layer. It is 7 to 10 days after pollination with the former and only three days with the latter.

MATERIAL AND METHOD

We tested 84 populations from 23 wild sunflower species, six annual ones (*H. argophyllus, H. petiolaris, H. annuus, H. debilis, H. neglectus, H. praecox*) and 17 perennial ones (*H. nuttallii, H. mollis, H. maximiliani, H. occidentalis, H. tuberosus, H. strumosus, H. decapetalus, H. rigidus, H. giganteus, H. grosseserratus, H. divaricatus, H. laevigatus, H. resinosus, H. salicifolius, H. eggertii, H. laetiflorus, H. glaucophyllus*). Tests were conducted on 100 achenes of each population. Percentage of achenes with the phytomelanin layer was determined with a saturated solution of potassium bichromate (K_2CrO_7) and sulphyric acid (H_2SO_4). Achenes were immersed in the reagent and inspected after 10 minutes. The achenes which became whitish did not possess the phytomelanin layer, those that retained their original color did possess it (Figure 1).

Figure 1. Achenes in saturated solution of potassium dichromate and sulphyric acid
A - without phytomelanin
B - with phytomelanin

RESULTS AND DISCUSSION

Differences were found in the percentage of achenes with the phytomelanin layer both among the species and among the populations of individual species. However, considering the pericarp firmness in wild sunflower species, the presence of the phytomelanin layer was unexpectedly low. The highest percentage of achenes with the phytomelanin layer was found for a population of *H. salicifolius*, 85.00%. High percentages were observed in the four *H. laevigatus* populations, 80.50% on average. Increased percentages were also seen in *H. strumosus, H. grosseserratus,* and *H. giganteus*, 73.00%, 66.00%, and 67.50%, respectively (Table 1). It should be mentioned that the species *H. tuberosus*, which is a source of resistance for a number of sunflower diseases and pests, had the phytomelanin layer in only 38.10% of achenes. Not a single *H. tuberosus* population had the phytomelanin layer in all achenes (100%), while seven out of the ten populations tested had the layer in less than 50% of achenes. Interesting results were obtained for the 13 populations of *H. maximiliani*. The percentage ranged from 0 to 100%, with the average of 56.92%. Of the three *H. mollis* populations tested, only one had a relatively high percentage of achenes with the phytomelanin layer (80.00%).

Table 1. Wild sunflower species with the phytomelanin layer (%)

Species	Number of populations	Achenes with phytomelanin (%)
H.annuus	3	36.67
H.argophyllus	5	39.00
H.petiolaris	11	25.00
H.praecox	3	21.67
H.debilis	1	30.00
H.neglectus	2	20.00
H.nuttallii	4	15.00
H.mollis	4	45.00
H.maximiliani	13	56.92
H.occidentalis	1	45.00
H.tuberosus	10	38.10
H.strumosus	5	73.00
H.decapetalus	3	33.33
H.rigidus	3	44.33
H.giganteus	2	67.50
H.grosseserratus	2	66.00
H.divaricatus	4	38.75
H.laevigatus	4	80.50
H.laetiflorus	1	20.00
H.glaucophyllus	1	10.00
H.resinosus	1	75.00
H.eggertii	1	55.00
H.salicifolius	1	85.00

In the six annual wild species, the phytomelanin layer was found in a small number of achenes, only 28.71%. The highest average percentage was in *H. argophyllus*, 39.00%, but the percentage did not exceed 60% in individual populations of that species. Although

the wild *H. annuus* had a lower average percentage than *H. argophyllus*, one of its populations had 70% of achenes with the phytomelanin layer. Among the eleven tested populations of the species *H. petiolaris*, not a single population had more than 40% of achenes with the phytomelanin layer.

It is understood that in addition to the presence of the phytomelanin layer, its quality too plays a role in sunflower resistance to the sunflower moth. Studies conducted so far have been few and the results obtained are not satisfactory. Assessments of phytomelanin quality, which primarily depends on its texture, have been done visually, on the basis of achene color (Bedov AND Škorić, 1989).

CONCLUSION

The study showed that there exist large differences in the presence of the phytomelanin layer among the wild sunflower species. Differences between individual populations of the same species are noteworthy.

Among the perennial species tested, the highest percentage of achenes with the phytomelanin layer was found for a population of *H. salicifolius*, 85.00%. Increased percentages were registered in *H. laevigatus, H. strumosus, H. grosseserratus*, and *H. giganteus*.

The tested annual wild species had considerably lower percentages than the perennial ones. The highest average percentage of achenes with the phytomelanin layer was found in *H. argophyllus*, the lowest in *H. neglectus*.

The study of the presence of the phytomelanin layer in achenes indicated that certain populations of perennial wild sunflower species may serve as sources of resistance to the sunflower moth.

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ESPECIES SILVESTRES DE GIRASOL – FUENTES DE RESISTENCIA A LA POLILLA DEL GIRASOL (*Homeosoma nebulella* HUBNER; *Homeosoma electellum* HULST)

RESUMEN

La introducción de variedades e hibridos de girasol es el mejor método de protección contra la polilla de girasol. La resistencia del girasol a estas plagas depende de la presencia de la capa de fitomelanina en el pericarpio. Un análisis de veintitres especies silvestres con una solución saturada de bicromato (K_2 C_r 0_7) y ácido sulfúrico (H_2 $S0_4$) ha mostrado que las especies perennes testadas tienen una capa de fitomelanina màs gruesas que las especies perennes. Diferencias han sido encontradas tambien entre especies asi como entre poblaciones de especies individuales. De las ochenta y cuatro poblaciones testadas solo seis tuvieron la capa de fitomelanina en 100% de los aquenios testados.

LES ESPÈCES SAUVAGES DE TOURNESOL – SOURCE DE RÉSISTANCE À LA PYRALE DU TOURNESOL (*Homeosmoma nebulella* Hubner, *Homeosoma electellum* Hulst)

RÉSUMÉ

L'introduction de variétés et d'hybrides de tournesol est la meilleure protection contre la pyrale du tournesol. La résistance du tournesol contre ce ravageur dépend de la présence d'une couche de phytomélanine dans le péricarpe. L'analyse de vingt trois espèces sauvages de tournesol par une solution saturée de bichromate ($K_2C_rO_7$) et d' acide sulphurique a montré que les espèces pérennes étudiées ont en moyenne une couche plus épaisse que les espèces annuelles. Des différences ont été également mises en évidence aussi bien entre les espéces qu'entre les populations d'une espèce donnée. Sur quatre vingt quatre populations étudiées seules six présentent une couche de phytomélanine dans 100% des achenes.