# CHEMICAL CONTROL OF SUNFLOWER CRYPTOGAMIC DISEASES IN ROMANIA

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Sunflower has become one of the main crops in Romania, representing the first vegetable edible oil source and an important source for industrial oil. Although the average seed and oil yields are quite stable and satisfactory, they are often significantly reduced by the attack of cryptogamic diseases.

Besides the most harmful major pathogens *(Plasmopara helianthi, Sclerotinia sclerotiorum, Botrytis cinerea, Phomopsis helianthi)*, sunflower has been more and more affected by the so called minor parasites like those belonging to the genera *Septoria, Verticillium, Sclerotium, Fusarium, Erisiphe* and *Alternaria* (Aćimović, 1980 ; Csép et al., 1983).

The specific pathogens, such as *Plasmopara helianthi, Puccinia helianthi,* and *Verticillium dahliae* proved to be much easier to control genetically then the polyphagous ones *(Sclerotinia sclerotiorum, Botrytis cinerea, Phoma macdonaldii)*, which possess a larger enzymatic complex (Vrânceanu et al., 1982). Because of the less successful breeding work for resistance to the last mentioned parasites, other means of the integrated control should be taken into consideration.

This paper presents the main results of the investigations concerning sunflower crop protection against diseases by chemical seed and plant treatments.

## MATERIALS AND METHODS

The experiments were carried out under field conditions in south and north-west regions of Romania, in Fundulea and Oradea locations respectively and under phytotron controlled environments of Fundulea, in the period of 1981—1983.

A suspension of zoosporangia ($10^3$/ml) was used for artificial infections with *Plasmopara helianthi.* The inoculum of *Sclerotinia sclerotiorum, Botrytis cinerea, Sclerotium bataticola* and *Phomopsis helianthi* consisted of a mycelium grown on autoclave sterilized oat grains (Iliescu and Pîrvu, 1977 ; Aćimović and Straser, 1981 ; Muntañola-Cvetcović et al., 1981).

The open-pollinated variety Record was used for all tests, because this cultivar manifests a higher susceptibility to the above-mentioned parasites, when compared to the most cultivated hybrids.

The sistemic fungicide Apron 35-SD (metalaxil) was included into insecto-fungicide mixture for preventing the downy mildew *(Plasmopara helianthi)* infections.

For seedling as well as stem and head rot control, the efficiency of the following fungicides was studied : Rovral 50 PM ; Rovral TS (based on iprodion), Ronilan 50 WP (vinclozolin), Benlate 50 (benomyl), Topsin M-70 (methylthiofanat), Rubigan (clorophenyl), Quinolate 15 S (Cu oxiquinoleat) and Tecto 450 (thyabendazol). These products were applied on the seed, alone or in a mixture of the following types : systemic + contact fungicides ; systemic + contact fungicides + insecticides.

Different systems of treatments in various vegetation stages were studied. Treatment efficiency was evaluated as a function of the application time and the number of sprayings performed.

Hand sprayers were utilised for the treatments on small plots and tractor and helicopter sprayers were used on large areas.

Systemic and local infection frequency was recorded in the case of downy mildew attack. For stem and head rots and canker, the frequency and intensity of the attack were noted, along with seed yields obtained on the respective plots.

## RESULTS AND DISCUSSION

Chemical treatments have been recommended as an important mean of the integrated control of sunflower disease, especially in recent communications (Marić, 1982 ; Csèp

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et al., 1983). The experiments carried out in phytotron showed that the product Apron 35 SD (400 g/100 kg seeds) had a clear efficiency in the prevention of the attack of both European and American races of *Plasmopara helianthi* (V r â n c e a n u et al., 1982).

Data presented in Table 1 point out that all products tested for seed desinfection are effective against sunflower rots in the seedling stage *(Sclerotinia sclerotiorum, Botrytis cinerea* and *Sclerotium bataticola),* the attack fre-

*Table 1*

**The effect of seed treatment with different fungicides on the frequency of sunflower seedling rots (Fundulea, 1982)**

| Products | Rate kg/ha | Germination % | Frequency % | | |
|---|---|---|---|---|---|
| | | | *Sclerotinia sclerotiorum* | *Botrytis cinerea* | *Sclerotium bataticola* |
| Rovral 50 WP | 0.2 | 97.5 | 5.4 | 3.2 | 8.6 |
| Rovral TS | 0.2 | 97.4 | 5.8 | 4.6 | 10.1 |
| Ronilan 50 WP | 0.2 | 96.5 | 5.5 | 3.3 | 17.4 |
| Sumilex 50 WP | 0.2 | 97.6 | 11.3 | 5.4 | 26.3 |
| Quinolate 15 S | 0.2 | 95.3 | 5.9 | 8.6 | — |
| Benlate 50 WP | 0.2 | 96.1 | 5.0 | 11.6 | 19.3 |
| Topsin M-70 | 0.2 | 94.6 | 9.9 | 9.8 | 17.4 |
| Untreated check | — | 96.8 | 79.0 | 75.5 | 66.3 |
| L.S.D. = 0.05 | | 2.4 | 4.3 | 3.3 | 6.7 |
| L.S.D. = 0.01 | | 3.9 | 8.4 | 6.3 | 12.0 |

quency values of the treated entries being significantly lower when compared with the untreated check. The respective fungicides kept this property when mixed together with Apron 35 SD and the incesticides Heptaclor 40 EC, Promet 40 SD and Furadan 35 ST. On the other hand, Apron 35 SD maintained its antiperonosporic effect in all mixtures. The insecticides proved also to be compatible with all fungicides tested. Based on these results, the concomitant treatment of sunflower seeds with the insecto-fungicide mixtures specified in Table 2 can be recommended.

The seed treatment against rots is efficient only in the first phases of plant development, eusuring a normal germination and emergence and therefore a good plant population. At the same time, a substantial decreasing of the spores and sclerotia reserves is encountered in most cases, stopping the disease dissemination at least partially.

The products Ronilan 50 WP, Rovral 50 WP and Benlate 50 WP, applied by two treatments after flowering had the best efficacy against

*Table 2*

**The effect of seed treatments with different fungicide and insecto-fungicide mixtures on disease and pest incidence (Fundulea and Oradea, 1982)**

| Products | Rate g/100 kg | Frequency % * | | | *Tanymecus dilaticollis, Agriotes* spp., *Opatrum sabulosum* (% saved plants) |
|---|---|---|---|---|---|
| | | *Plasmopara helianthi* | *Sclerotinia sclerotiorum* | *Botrytis cinerea* | |
| Apron 35-SD + Rovral 50 WP | 400 + 200 | 0 | 5.8 | 3.1 | — |
| Apron 35-SD + Ronilan 50 WP | 400 + 200 | 0 | 5.4 | 2.0 | — |
| Apron 35-SD + Benlate 50 WP | 400 + 200 | 0.1 | 5.0 | 8.9 | — |
| Apron 35-SD + Rovral 50 WP + Heptaclor 40 EC | 400 + 200 + 600 | 0 | 6.0 | 3.3 | 82.5 |
| Apron 35-SD + Benlate 50 WP + Promet 40 SD | 400 + 200 250 | 0 | 5.7 | 8.6 | 100 |
| Apron 35 SD + Ronilan 50 WP + Furadan 35 ST | 400 + 200 + 200 | 0 | 5.0 | 2.1 | 96.5 |
| Apron 35 SD + Ronilan 50 WP + Furadan 35 ST | 400 + 200 + 280 | 0 | 4.8 | 1.9 | 100 |
| Untreated check | — | 98.3 | 73.5 | 83.4 | 45.5 |
| L.S.D. 0.05 | | | 4.6 | 2.4 | 12.5 |
| L.S.D. 0.01 | | | 11.5 | 5.3 | 19.0 |

* Observations were recorded 30 days after seeding.

the head attack of *Sclerotinia sclerotiorum* (Table 3) and *Botrytis cinerea* (Table 4). As shown in Table 5, the prevention of the attack depended on the time of the first treatment application. Even applying a single treatment but at the optimum stage, i.e. 6—8 pairs of leaves, the results obtained were better that when three treatments after flowering were applied. The best results were obtained by two treatment applications before flowering, i.e. one treatment at the stage of 6—8 pairs of leaves and the other at the head initiation time. Data presented in Table 6 show a remarkable efficacy of the treatments applied

The application of the first treatment by terrestrial equipment, in the stage of 6–8 pairs of leaves, for controlling sunflower stem canker (Phomopsis sp.).

The application of the second treatment by helicopter, at the head initiation time, for controlling sunflower stem canker (Phomopsis sp.).

*Table 3*

**Degree of *Sclerotinia sclerotiorum* head attack (DA %) noted after treatments with different fungicides, applied after sunflower flowering**

| Products | Rate (l reat.) kg/ha | Natural infection Fundulea, 1982 | | | Artificial infection * Fundulea, 1983 | | |
|---|---|---|---|---|---|---|---|
| | | Observation were performed before: | | | | | |
| | | treat. I | treat. II | harvesting | treat. I | treat. II | harvesting |
| Rovral 50 WP | 1.5 | 2.1 | 3.4 | 4.4 | 0.5 | 8.3 | 9.3 |
| Ronilan 50 WP | 1.5 | 2.1 | 2.9 | 4.1 | 0.5 | 7.9 | 8.6 |
| Sumilex 50 WP | 1.5 | 2.1 | 9.4 | 13.5 | 0.5 | 15.6 | 17.2 |
| Benlate 50 WP | 1.5 | 2.1 | 5.3 | 6.3 | 0.5 | 7.8 | 12.6 |
| Untreated check | — | 2.1 | 17.4 | 56.4 | 0.5 | 53.4 | 83.5 |
| L.S.D. 0.05 | | | | 4.6 | | | 5.1 |
| L.S.D. 0.01 | | | | 9.3 | | | 13.3 |

* Artificial infection was performed between the two treatments.

*Table 4*

**Degree of *Botrytis cinerea* head attack (DA %) noted after treatments with different fungicides, applied after sunflower flowering**

| Products | Rate (l reat.) kg/ha | Natural infection Oradea, 1982 | | | Artificial infection * Fundulea, 1983 | | |
|---|---|---|---|---|---|---|---|
| | | Observation were performed before: | | | | | |
| | | treat. I | treat. II | harvesting | treat. I | treat. II | harvesting |
| Rovral 50 WP | 1.5 | 1.6 | 2.4 | 5.5 | 0.5 | 4.2 | 6.5 |
| Ronilan 50 WP | 1.5 | 1.6 | 2.1 | 5.3 | 0.5 | 4.9 | 5.8 |
| Sumilex 50 WP | 1.5 | 1.6 | 5.6 | 11.3 | 0.5 | 10.4 | 13.4 |
| Benlate 50 WP | 1.5 | 1.6 | 4.3 | 10.6 | 0.5 | 10.6 | 10.9 |
| Untreated check | — | 1.6 | 21.4 | 59.5 | 0.5 | 29.4 | 34.4 |
| L.S.D. 0.05 | | | | 2.1 | | | 3.3 |
| L.S.D. 0.01 | | | | 5.7 | | | 7.1 |

* Artificial infection was performed between the two treatments.

*Table 5*

**The influence of the number of fungicide treatments * and their application time on the attack of *Phomopsis* sp. and *Alternaria* sp. and on sunflower seed yield (Oradea, 1982)**

| No. of treatments | 12.06.82 | 21.06.82 | 5.07.82 | 18.07.82 | 5.08.82 | 25.08.82 | Degree of attack (%) | | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|
| | 6—8 pairs of leaveas | head initiation | budding stage | beginning of flowering | end of flowering | physiological maturity | *Phomopsis* sp. | *Alternaria* sp. | |
| 6 | × | × | × | × | × | × | 0.3 | 0.9 | 2 905 *** |
| 3 | × | × | × | | | | 2.6 | 21.3 | 2 560 *** |
| 3 | | × | × | × | | | 8.8 | 17.3 | 2 395 *** |
| 3 | | | × | × | × | | 19.3 | 6.5 | 2 065 ** |
| 3 | | | | × | × | × | 20.5 | 9.4 | 2 035 ** |
| 3 | × | | × | | × | | 16.4 | 11.3 | 2 350 *** |
| 3 | | × | | × | | × | 19.3 | 6.4 | 2 245 *** |
| 2 | × | × | | | | | 7.3 | 26.4 | 2 425 *** |
| 2 | | × | × | | | | 12.4 | 24.5 | 2 140 *** |
| 2 | | | × | × | | | 21.4 | 13.2 | 1 935 * |
| 2 | | | | × | × | | 19.5 | 6.4 | 1 765 |
| 1 | × | | | | | | 13.1 | 31.6 | 2 009 ** |
| 1 | | × | | | | | 20.9 | 28.3 | 1 885 * |
| 1 | | | × | | | | 26.4 | 27.5 | 1 855 |
| — | | | | | | | 34.5 | 31.4 | 1 585 |

S.D.L. 5% = 282
1% = 378
0.1% = 499

* Ronilan 1 kg/ha + Fundazol 1.5 kg/ha/treatment.

*Table 6*

**The influence of different fungicides on the attack of sunflower canker (*Phomopsis* sp.) (natural infection, Oradea, 1982—1983)**

| Products | Rate kg(l)/ha (1 treat.) | 2 treatments before flowering | | |
|---|---|---|---|---|
| | | frequency (%) | broken plants (%) | seed yield (kg/ha) |
| Benlate 50 | 1.5 | 6.1 | 0 | 2 030 |
| Ronilan + Bavistin | 0.75 + 0.5 | 7.6 | 1.6 | 1 910 |
| Rovral FLO | 4 | 16.4 | 16.5 | 1 530 |
| Tecto 450 | 2 | 7.9 | 0 | 1 890 |
| Rubigan | 1.5 | 5.4 | 0 | 2 070 |
| Untreated check | — | 88.3 | 25.0 | 830 |

before flowering for sunflower canker (*Phomopsis* sp.) control. Rubigan (1 l/ha/treat.), Benlate 50 (1.5 kg/ha/treat.), Tecto 450 (2 l/ha/treat.) and Ronilan 50 WP + Bavistin (0.75 kg + 0.5 l/ha/treat.) were the products with the best results. Two treatments with these fungicides, the first in the stage of 6—8 pairs of leaves and the second at the head initiation time, assured a seed yield similar to that of the untreated check. The application moment is thus particularly important in this case, because the prevention of *Phomopsis* sp. installation is more efficient than the curative treatments.

One of the most important aspects of sunflower disease chemical control is the use of a suitable technique for fungicide application having in view that the spraying solution has to cover the whole plant. The lower part of the plant should be treated primarily in order to achieve a good protection against *Phomopsis* sp. (Marić, 1982).

## CONCLUSIONS

Chemical control represents an important component of the modern concept on the integrated sunflower disease prevention, along with genetic resistance and agrotechnical measures.

Certain fungicide seed treatments presented a very good efficiency in controlling the main diseases in the first vegetation stages. Thus two treatments before flowering, one in the stage of 6—8 pairs of leaves and the second at the head initiation time had the best efficiency in *Phomopsis* prevention.

When chemical treatment were applied after flowering, one at the end of blooming time and the other after 10—15 days, *Phomopsis* attack was controlled only partially, but *Sclerotinia sclerotiorum* and *Botrytis cinerea* were stopped significantly.

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## LA LUTTE CHIMIQUE CONTRE LES MALADIES CRYPTOGAMIQUES DU TOURNESOL EN ROUMANIE


*Résumé*

Les traitements chimiques des semences et ceux appliqués en végétation à coté de la résistance génétique des plantes et de certaines mesures agrotechniques consituent les principaux éléments de la lutte integrée.

Pour prévenir les attaques de *Sclerotinia sclerotiorum et Botrytis cinerea* pendant la levée et dans le stade de plantule, les meilleurs résultats ont été obtenus par le traitement des semences avec l'un des produits suivants : Ronilan 50 WP, Rovral 50 WP, Benlate 50 WP et Quinolate 15 S (200 g/100 kg semences). Ces produits restent actifs même en association avec Apron 35 SD (fongicide anti-péronosporique) ou avec certains insecticides utilisés pour la lutte contre des ravageurs du sol (*Tanymecus dilaticollis, Agriotes* spp.).

Deux traitements, le premier en fin de floraison et le deuxième après 10 à 15 jours, appliqués avec un des produits Ronilan 50 WP, Rovral 50 WP ou Benlate 50 WP (1,5 kg/ha/l traitement), ont eu une bonne efficacité dans la lutte contre la pourriture de la tige et du capitule.

L'attaque de *Phomopsis helianthi* a été prévenu en bonnes conditions par l'application de deux traitements, le premier dans le stade de 6—8 paires de feuilles, le deuxième pendant la formation du bouton floral, en utilisant les fongicides systémiques Rubigan, Benlate 50 WP, Tecto 450 ou l'association Ronilan 50 WP + Bavistin (0,750 + 0,5 kg/ha/l traitement). Le dernier traitement, étant une combinaison entre un fongicide systémique et un fongicide de contact, a un effet synergique, en déterminant aussi la réduction de l'attaque de *Sclerotinia sclerotiorum* et *Botrytis cinerea*.

## LA LUCHA QUÍMICA CONTRA LAS ENFERMEDADES CRIPTÓGENAS DEL GIRASOL EN RUMANÍA


*Resúmen*

Los tratamientos químicos de la semilla y aquellos aplicados en el período de vegetación costituyen, junto a la resistencia genética de las plantas y de algunas medidas agrotécnicas, los principales eslabones de toda la lucha.

Para prevenir el ataque de la *Sclerotinia sclerotiorum* y de *Botrytis cinerea* en el período de aparición de la planta y en el estadio de plantula, los mejores resultados fueron obtenidos en el tratamiento de las semillas con uno de los produjos: Ronilan 50 WP, Benlate 50 WP y Quinolate 15 S (200 g/100 kg semillas). Estos produjos permanecen activos también en mezcla con Apron 35 SD (fungicida antiperonospórico) o con otros insecticidas utilizados en la lucha contra los parasitos del suelo (*Tanymecus dilaticollis, Agriotes* sp.).

Dos de los tratamientos con uno de los produjos Ronilan 50 WP, Rovral 50 WP o Benlate 50 WP (1,5 kg/ha/l tratamiento), el primero al final de la floración y el segundo después de 10—15 dias, tuvieron gran eficacia en la lucha contra la podredumbre del tallo y de los capitulos.

El ataque del hongo *Phomopsis helianthi* fue prevenido en buenos condiciones por la aplicación de dos tratamientos, el primero en la fase de 6—8 parejas de hojas, el segundo al formarse el botón floral, utilizándose los fungicidas sistémicas Rubigan, Benlate 50 WP, Tecto 450 o la combinación de Ronilan 50 WP y Bavistin (0,750 más 0,5 kg/ha/l tratamiento). La combinación mencionada, siendo una combinación entre un fungicida sistémico y uno de contacto, tiene un efecto sinérgico, que determina también la reducción del ataque de la *Sclerotinia sclerotiorum* y de *Botrytis cinerea.*