

CONTROL OF SUNFLOWER DOWNY MILDEW BY CHEMICAL TREATMENTS

HORIA ILIESCU

Research Institute for Cereals and
Industrial Crops, 8264 Fundulea,
Ilfov, Romania

Sunflower is the principal oil seed crop in Romania where it covers more than 500,000 hectares. The average yields are however even in favourable years smaller than the biological potential of the existing cultivars and this could be ascribed to some extent to fungal diseases.

Until not long ago and mainly in springs with prolonged cold and humid weather the disease which caused the most serious economic losses to sunflower crops was downy mildew incited by *Plasmopara helianthi* Novot. At present, due to the ever increased cultivation of the resistant hybrids, the economic impact of this disease is decreasing, although it still threatens the crops in certain regions (V r â n - c e a n u et al., 1978).

Our studies on the chemical control of sunflower downy mildew aimed at establishing a protection method applicable in areas where resistant hybrids have not yet been introduced. The experiments were carried out at the Research Institute for Cereals and Industrial Crops of Fundulea, in 1978 and 1979.

MATERIALS AND METHODS

The experiments were conducted under irrigation, in a nursery where sunflowers have been cultivated continuously for 11 years.

The random block method used consisted of 5 replications with 1125 plants per variant. The determinations made in 1978 revealed the presence of 32—36 oospores per cm³ of soil. Oospore density decreased with the sampling depth, but values lower than 10 oospores per cm³ were not recorded (Iliescu et al., 1977).

The onset of primary infections was favoured by the high infection potential of the soil. The appearance of systemic, partial-systemic or local infections was induced by the flight of zoosporangia formed on the leaves of the in-

fecting plants. The determinations made after abundant rainfalls or irrigations using smeared trap slides, demonstrated the presence of 15—20 zoosporangia per cm² in 24 hours.

The open-pollinated variety Record was used in all experiments as susceptible cultivar.

The investigations concerning the absorption and transportation of the fungistatic products in sunflower seedlings, i.e. the duration of protection against secondary infections by seed or soil treatment, were carried out in phytotron, under highly favourable conditions for artificial infections ($t = 16-18^{\circ}\text{C}$, $\text{RH} = 95-100\%$).

The following fungicides were used :

— PREVICUR N, chemical name : propyl-[3-(dimethyl-amino)propyl]-carbamate monohydrochloride, developed by Schering AG Berlin/Bergkamen ;

— APRON 35-SD, chemical name : methyl D, L-N-(2,6-dimethylphenyl)-N-(2'-methoxyacetyl) alaninate, developed by Ciba-Geigy ;

— RIDOMIL 25 WP and RIDOMIL 5 G, with the same active ingredients as APRON 35-SD, but with different formulations ;

— CURZATE 50, chemical name : 2-cyano-N-(ethylamino) carbonyl-2-(methoxyimino) acetamide, developed by Du Pont de Nemours Int. S.A. ;

— DITHANE M-45, chemical name : ethylen bis-dithio-carbamate magneze and zinc, developed by Rohm and Haas Co.

The treatments with PREVICUR N, APRON 35-SD and the mixture CURZATE 50 + DITHANE M-45 were applied as seed dressing by slurry method.

RIDOMIL 25 WP was used as spray treatment on the rows, a few hours after planting, and the granules of RIDOMIL 5 G were applied at planting with a granule-microapplicator.

RESULTS AND DISCUSSION

The products under study were evaluated as regards their phytotoxic effect on seed germination, seedling emergence and the subsequent growth of sunflower plants. The height of the plants resulted from the treated seeds was measured 20 and 45 days after planting under field conditions. The data shown in Table 1,

Table 1
Phytotoxicity of several fungicides applied to sunflower seeds

Fungicides	Rate g a.i./q	Germination	Emergence	Plant height (cm)	
				20 days	45 days
				Previcur N	200
Curzate 50 + Dithane M-45	16 + 128	98.1	95.6	7.2	28.4
Curzate 50 + Dithane M-45	20 + 128	97.9	95.1	8.1	27.1
Curzate 50 + Dithane M-45	25 + 128	98.9	96.1	10.3	29.9
Apron 35-SD	210	98.5	95.9	3.9	28.7
Untreated check	—	98.3	95.7	8.7	29.1

demonstrate that none of the fungicides tested has a phytotoxic effect on seed germination, emergence and plant growth.

For determining the efficacy of the fungicides, observations on the frequency of downy mildew attack were made for both systemic (after 20 and 45 days) and local infections (after 30 and 60 days).

The observations on the appearance of local or partial systemic infections were carried out after the intense sporulation of the fungus, permitting the exposure of the plants to a high density of zoosporangia in the air. In this way, a maximum frequency of plants with local infection (98—100%) was obtained in the untreated plots.

The best results were obtained with the fungicide APRON 35-SD applied as seed treatment at the rate of 0.6 kg commercial formulation per 100 kg of seeds. This fungicide is highly effective in the control of systemic infections, with a minimum protective duration of 45 days (Table 2). The control provided by RIDOMIL 5 G (7.5 kg/ha), PREVICUR N (0.250 l/q) and the mixture CURZATE 50 + DITHANE M-45 (25 + 128 g a.i./q) was also satisfactory.

Unfortunately, the small quantity of the chemical product adhering to the seed or applied to the soil and then translocated into the plant due to the systemic nature of these substances,

Table 2

Control of downy mildew (*Plasmopara helianthi* Novot.) by chemical seed and soil treatments

Fungicides	Rates * of application	<i>Plasmopara helianthi</i> (F %)			
		systemic infections		local infections	
		20 days	45 days	30 days	60 days
Previcur N	250 ml/q	6.3	7.4	10.4	16.3
Curzate 50 + Dithane M-45	32 g + 160 g/q	13.4	26.4	9.6	39.4
Curzate 50 + Dithane M-45	40 g + 160 g/q	10.1	19.4	13.4	41.3
Curzate 50 + Dithane M-45	50 g + 160 g/q	2.1	12.5	10.3	31.6
Apron 35-SD	600 g/q	0	0	3.1	36.4
Apron 35-SD + Ridomil 25 WP	600 g/q + 1,000 g/q	0	0	2.6	35.4
Apron 35-SD Ridomil 5 G	600 g/q + 7,500 g/ha	0	0.3	3.7	39.3
Ridomil 5 G	7,500 g/ha	0.7	6.3	11.4	64.5
Ridomil 25 WP	1,500 g/ha	6.1	13.4	19.4	83.7
Untreated check	—	64.5	96.4	100	100

* Formulated product.

cannot provide a complete protection for a longer period. After 60 days, their efficacy is considerably diminished due to both the probable degradation of the substances or the decrease of their fungistatic activity and the dilution of the active ingredient in the cell sap or in the liquids moving in the plant (Urech et al., 1977).

However, the lasting effect of APRON 35-SD covers the period of maximum susceptibility to systemic invasion of the fungus and after 45—50 days from sunflower planting, the secondary local infections have little effect on seed yield.

In view of the evaluation of the possible protection against secondary infections, a trial was carried out in phytotron, using treated seeds and sterilized soil. Fourteen days after planting, during the stage of maximum susceptibility, the plants were infected artificially with a suspension of zoosporangia under optimum inoculation conditions ($t = 18^{\circ}\text{C}$; $\text{RH} = 95\text{—}100\%$). Observations were carried out 30 days after planting and the frequency of systemic and local infections was recorded. It was found that 14 days after the artificial inoculations were made, the protection level against systemic infections was good, but it was less satisfactory against the local infections (Table 3).

Studies are now being carried out in phytotron on the duration of the protective action of the investigated fungicides, for establishing the phenological stage when their effect ceases.

Table 3

Effect of several fungicides on the occurrence of secondary infections caused by *Plasmopara helianthi* Novot. (artificial infections in phytotron; RH = 100%, t = 18°C)

Fungicides	Rates * of application	Emerg- ed plants	Infected plants <i>Plasmopara helianthi</i> (30 days)	
			sys- temic	local infec- tions
Previcur N	250 ml/q	146	2	3
Curzate 50 + Dithane M-45	32 + 160 g/q	143	8	13
Curzate 50 + Dithane M-45	40 + 160 g/q	136	3	12
Curzate 50 + Dithane M-45	50 + 160 g/q	142	0	10
Apron 35-SD	600 g/q	149	0	2
Ridomil 25 WP	1,500 g/q	143		19
Ridomil 5 G	7,500 g/q	141	6	12
Untreated check	—	147	111	31

* Formulated product.

CONCLUSIONS

The products tested with the purpose of controlling the attack of the fungus *Plasmopara helianthi* have no phytotoxic effects on the germination, emergence and plant height.

The fungicides APRON 35-SD, RIDOMIL 5 G, PREVICUR N and the mixture CURZATE 50 + DITHANE M-45 offer a good protection against the primary and secondary systemic infections. Their efficacy decreases gradually and a certain rate of secondary local infections can be noticed as the plant growth advances.

Studies are still necessary in order to determine accurately the duration of the activity of the products applied as seed or soil treatments.

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LA PRÉVENTION ET LA LUTTE CONTRE LE MILDIU DU TOURNESOL PAR DES TRAITEMENTS CHIMIQUES

Résumé

On présente les données expérimentales sur les possibilités de prévenir l'apparition des infections systémiques et locales de mildiou par des traitements chimiques appliqués sur les semences ou dans le sol. Les essais ont été effectués avec les fongicides Apron 35-SD (0,6 kg/q), Ridomil 5 G (7,5 kg/ha), Ridomil 25 WP (1,5 kg/ha), Previcur N (0,25 l/q) et une association de Curzate 50 et Dithane M-45 (40 + 285 g/q) en des conditions de forte infection naturelle ou d'infection artificielle dans le phytotron.

Des résultats remarquables ont été obtenus avec l'Apron 35-SD appliqué sur semences par la méthode «slurry» aussi bien contre les infections primaires que contre celles secondaires.

Les autres fongicides essayés ont donné eux-aussi des résultats satisfaisants, surtout en ce qui concerne la protection contre les infections systémiques pendant les premières phases de développement des plantes.

Des recherches sur la durée de l'action des fongicides sur les infections secondaires de mildiou sont en train d'être effectuées.

PREVENCIÓN Y COMBATE DEL MILDIU DEL GIRASOL POR TRATAMIENTOS QUÍMICOS

Resúmen

Están presentados datos experimentales respecto a la posibilidad de prevenir la aparición de las infecciones sistémicas y locales de mildiu, con la ayuda de los tratamientos químicos en la semilla o en el suelo. Las investigaciones se han efectuado utilizando fungicidas Apron 35-SD (0,6 kg/q), Ridomil 5 G (7,5 kg/ha), Ridomil 25 WP (1,5 kg/ha), Previcur N (0,25 l/q) y una mezcla de Curzate 50 y Dithane M-45 (40 + 285 g/q) en condiciones de infección natural fuerte o bien de infección artificial en fitotron.

Resultados remarquables se han obtenido con el fungicida Apron 35-SD aplicado a la semilla por el método slurry, tanto en contra de las infecciones primarias como a las secundarias.

Los resultados obtenidos con los demás productos fueron también satisfactorios, especialmente en lo que se refiere a la protección contra las infecciones sistémicas durante las primeras fases de desarrollo de las plantas.

Se continúan las investigaciones con vistas a establecer el período de acción de las fungicidas sobre las infecciones secundarias de mildiu.